

To divide the pleura it is desirable that a moderate degree only of intrapulmonary pressure be employed, so that the lung may collapse to an extent to recede from the knife and escape injury. Moreover, the knife must be handled with proper caution to avoid sudden entrance into the lung, as the pleura is divided. The incision of the pleura extends through the entire length of the seventh intercostal space, and an examination is made to determine the operability of the tumor. If we decide to proceed, we now complete the posterior, vertical part of the incision, which requires the division of the seventh, sixth, fifth, and fourth ribs between their angles and tubercles, the intercostal muscles, the intercostal vessels, which must be caught and tied, and the intercostal nerves.

I should like to say in this connection, that I consider the incision just described as the *normal thorax incision*, whenever plenty of room is needed. Of course it may be modified for individual purposes by

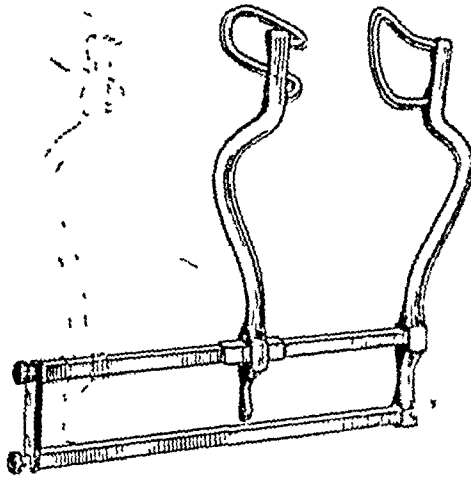


FIG 7—Rib spreader

selecting another intercostal space in place of the seventh, likewise, the case may require the division of a greater or smaller number of ribs than the above-mentioned four. The incision is surely superior to extensive resection of ribs, as the integrity of the thoracic wall is preserved. In this respect it is similar to the osteoplastic resection of the skull.

A rib spreader is now placed between the seventh and eighth ribs. For spreading the ribs a number of specially constructed instruments exist. I have had much better satisfaction with an instrument that was not designed for the purpose, viz., Balfour's abdominal retractor. This consists of two parts, the main part being the spreader. I have adapted it for this purpose by remodelling it so as to spread 5 cm. farther (Fig 7). Its full spread, 17 cm., will be required only in very large chests.

ANNALS OF SURGERY

A MONTHLY REVIEW OF SURGICAL SCIENCE AND PRACTICE

EDITED BY
LEWIS STEPHEN PILCHER, M.D., LL.D.,
OF NEW YORK

WITH THE COLLABORATION OF

J WILLIAM WHITE, M.D., LL.D., OF PHILADELPHIA, Professor of Surgery in the University of Pennsylvania	SIR WILLIAM MACEWEN, M.D., LL.D., OF GLASGOW, Professor of Surgery in the University of Glasgow
--	--

SIR W. WATSON CHEYNE, C.B., F.R.S.,
OF LONDON,
Professor of Surgery in King's College

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OCCLUSION OF THE PYLORUS

the mucous membrane from the muscular coats of the stomach without opening its lumen

Some recent workers, among whom may be mentioned Polya and Bircher, have suggested that instead of fascia being used to produce occlusion a peritoneal band, such as the ligamentum teres of the liver, should be used, this either being entirely freed from its attachments or left attached at its hepatic end. However, the results have not been satisfactory

In our experimental work we have attempted, as far as possible, to perform some form of occlusion from each one of these groups. In all we did 19 operations. Unfortunately, the kennels had been affected with distemper and the mortality from this condition was extremely high. Our technic in general was to make a three- or four-inch left rectus incision and perform a gastrojejunostomy with four rows of sutures, and then to perform one of the so-called pyloric occlusions. The methods used were Biondi's, Wilms', silk ligature, and chromic catgut ligature

By means of Biondi's method (Table I) we operated upon three dogs. In the first one, the muscular coats were separated from the mucous membrane with difficulty, the mucous membrane tube being opened and the animal dying later of peritonitis. The result in one of the others was entirely satisfactory, the pylorus being found completely obstructed. In the third dog, however, it was found that the lumen of the intestine had become entirely patent, the only evidence of the operation being a thickened ring of tissue surrounded by dense adhesions. This was rather disappointing, as we firmly believed that if any of the methods used were successful, it would surely be this one.

In occlusion with the fascial band (Table II) seven dogs were operated upon. One of these (dog No. 2) lived only a short time and should not be included in our results. Only one of the animals showed what could be considered a complete functional occlusion. The X-ray, taken some three weeks after operation, showed complete closure of the pylorus, and at autopsy water contained in the stomach did not pass into the duodenum by gravity. In the remaining five dogs the lumen was patent with, however, more or less constriction, as the fascial grafts (Figs 7 and 8) in all cases had taken and the pylorus was surrounded by dense adhesions. There was undoubtedly some stenosis and in all probability only a small amount of stomach contents passed through, the greater part going through the gastrojejunal anastomosis.

By means of the silk ligature (Table III) we operated upon six dogs. Three of these died within four days. Of the remaining three

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OCCLUSION OF THE PYLORUS

adherent to the pyloric portion of the stomach, the pylorus was found covered with adhesions, the gastro-enterostomy was patent and the lumen of the pylorus appeared slightly stenosed

EXPERIMENT No 16—November 13, 1914 Terrier, male

Operation—Posterior gastrojejunostomy was done and the pylorus obstructed by suturing a strip of fascia $\frac{1}{4}$ inch wide, taken from the anterior sheath of the rectus, around the pylorus

Result—Dog killed January 8, 56 days after operation The gastro-enterostomy was found to be patent, there were many adhesions around the pylorus binding it to the liver, the omentum was very adherent and the fascial transplant was healthy The pylorus was constricted but it was still patent The gastro-enterostomy anastomosis was wide open

EXPERIMENT No 17—November 24, 1914 Terrier, male

Operation—Gastrojejunostomy was done and pylorus was obstructed by tying a double piece of No 5 silk around the pylorus

Result—Died December 5, 11 days after operation Cause of death distemper Gastro-enterostomy patent Large amount of adhesions around pylorus in midst of which strand of silk is found There is only a partial constriction of the lumen

EXPERIMENT No 18—November 24, 1914 Yellow mongrel, male

Operation—Gastrojejunostomy was done and pylorus was obstructed by tying a double piece of No 5 silk around the pylorus

Result—Died December 4, 10 days after operation Cause of death distemper Gastro-enterostomy patent Many thick adhesions about the pylorus in midst of which strand of silk is found Material in stomach passes easily into the duodenum On opening duodenum, the lumen is found entirely patent

CLINICAL CASES

Patient, Salvatore I, male, aged twenty Admitted June 9, 1914

Previous History—Unimportant

Present Illness—For a year past patient has suffered frequently from attacks of pain in the abdomen, made worse by taking food Was under observation in the New York Hospital in spring of 1914 The stomach contents showed blood and hyperacidity The string tests were sometimes positive, sometimes negative X-ray pictures negative The patient's distress disappeared under soft solid diet and rest in bed Readmitted June 9, with recurrence of all his troubles

Operation (June 13, 1914)—Irregular, hard, callous ulcer found on the posterior superior wall of the stomach juxtapyloric A posterior no-loop gastro-enterostomy—5 rows of sutures—performed with Carwardin clamps A strip of fascia, $4\frac{1}{2}$ inches long by 1 inch wide, removed from fascia lata and fastened snugly around stomach at the pylorus Shortly after the pylorus was ligated the patient developed a severe hiccough although fully anæsthetized

CONTRIBUTORS TO VOLUME LXI

- ALEXANDER, EMORY G, M D, of Philadelphia, Associate Surgeon to the Episcopal Hospital
- BABLER, EDMUND ADAM, M D, of St Louis, Mo, Visiting Surgeon, City Hospital, Surgeon, Deaconess Hospital
- BALFOUR, DONALD C, M D, of Rochester, Minn
- BARBER, W HOWARD, M D, of New York
- BARRIE, GEORGE, M D, of New York
- BEEKMAN, FENWICK, M D, of New York, Adjunct Assistant Surgeon to Bellevue Hospital
- BEER, EDWIN, M D, of New York
- BERNHEIM, BERTRAM M, M D, of Baltimore, Md, Instructor in Clinical Surgery, The Johns Hopkins University
- BOGART, ARTHUR H, M D, of Brooklyn, N Y, Surgeon to The Methodist Episcopal and Coney Island Hospitals, Assistant Surgeon to the Kings County Hospital
- BOOKMAN, MILTON R, M D, of New York, Adjunct Attending Surgeon, Lebanon Hospital
- BRENIZER, ADDISON G, M D, of Charlotte, N C
- BREWER, GEORGE EMERSON, M D, of New York
- BURNHAM, A CAMPBELL, M D, of New York
- CARMAN, R D, M D, of Rochester, Minn
- CARNETT, J B, M D, of Philadelphia, Associate in Surgery, University of Pennsylvania, Assistant Surgeon to University of Pennsylvania Hospital, Surgeon to the Philadelphia General and the American Stomach Hospitals
- CARROLL, ALBERT HYNSON, M D, of Baltimore, Md, Associate in Gastro-Enterology in the University Hospital
- CASTLE, OTTO L, M D, of Kansas City, Mo
- CHANEX, R H, M D, of Philadelphia
- CHURCHMAN, JOHN W, M D, of New Haven, Conn, Professor of Surgery in Yale University
- COFFEY, ROBERT C, M D, of Portland, Oregon
- COLL, LEWIS GREGORY, M D, of New York
- *CRILE, GEORGE W, M D, of Cleveland, Ohio
- DAVIS, BENJAMIN F, M D, of Chicago, Nicholas Senn Fellow in Surgery, Rush Medical College

PAINFUL SUBCUTANEOUS TUBERCLE*

By H. R. OWEN, M. D.

OF PHILADELPHIA

A PAINFUL subcutaneous tubercle is literally what the name denotes. Were the name changed to painful subcutaneous neurofibroma, not only the chief symptoms but also the pathology would be told. These tumors have been described by A. Petit, Cheselden, Camper, Paget and others. Mr. William Wood¹ in 1812 described them, and gave to them the name they have since borne. The subject is discussed in a few of our modern surgeries and in few pathologies. The older surgeons treated the subject to greater length. Good descriptions may be found in Agnew's Surgery and Gross's Surgery. Of the modern surgeries, DaCosta, Treves, and Rose and Carliss²⁶ relate the occurrences of these tumors. Whereas painful subcutaneous tubercles are not common, on the other hand they cannot be called rare. When met with, they are not difficult of diagnosis. The seat of the growth of these little tumors is in the subcutaneous areolar and adipose tissue; they are usually found on the extremities, more often on the lower extremities than on the upper. Gross² is the only writer whose experience led him to believe that the upper extremity was the more usual location for their growth. He found they occurred more frequently on the shoulder and arm. In one case, which I had the opportunity of seeing with Dr. DaCosta last winter, the tumor was in the subcutaneous tissue of the chest. This specimen was afterward shown before the Academy of Surgery. Brodie³ reported cases in which the tumor occurred upon the face. Robert W. Smith⁴ reported two cases occurring on the fingers, and Sir James Paget⁵ removed such a tumor from a thumb. Whereas the painful tubercles usually lie just beneath the skin, they are seldom attached thereto. A painful tubercle has a well-defined capsule which is usually loosely connected with the surrounding tissues. The overlying skin is not usually discolored, but, in the exceptional case when the tumor is attached to the skin, the skin is thin, polished and the superficial blood-vessels are tortuous and enlarged. This, as stated, however, is exceptional, as the tumor is usually freely movable, and the palpating fingers can move the tumor around under the skin within

* Read before the Philadelphia Academy of Surgery, December 7, 1914.

CONTRIBUTORS TO VOLUME LXI

- DAVIS, JOHN STAIGE, M D, of Baltimore
- DEAVER, JOHN B, M D, of Philadelphia
- DELATOUR, H BEECKMAN, M D, of Brooklyn, N Y
- DERBY, RICHARD, M D, of the American Ambulance in Paris
- DOUGLAS, JOHN, M D, of New York
- DOWD, CHARLES N, M D, of New York, Surgeon to the Roosevelt Hospital
- DRAPER, JOHN WILLIAM, M D, of New York
- EASTMAN, JOSEPH RILUS, M D, of Indianapolis, Ind
- ELY, LEONARD W, M D, of San Francisco
- FINOCHIETTO, RICARDO, M D, of Buenos Aires, Argentina
- FISHER, A O, M D, of St Louis, Mo
- FREEMAN, LEONARD, M D, of Denver, Colo
- GALLIE, W E, M B, of Toronto, Ontario, Associate Surgeon, Hospital for Sick Children
- GIBSON, CHARLES L, M D, of New York, Surgeon to the First (Cornell) Surgical Division of the New York Hospital
- GILL, A BRUCE, M D, of Philadelphia, Pa
- GINSBURG, NATHANIEL, M D, of Philadelphia
- GOODMAN, CHARLES, M D, of New York
- GUERRY, LEGRAND, M D, of Columbia, S C
- HORSLEY, J SHELTON, M D, of Richmond, Va
- HUBBARD, J C, M D, of Boston, Mass
- HUNNICUTT, JOHN A, M D, of Athens, Ga
- IRWIN, HAMNER CARSON, M D, of Rochester, Minn
- JUDD, EDWARD STARR, M D, of Rochester, Minn
- KENYON, JAMES H M D, of New York
- KIMPTON, A R, M D, of Boston, Mass
- LEWIS, BRANSFORD, M D, of St Louis, Mo, Professor of Genito-Urinary Surgery, in the Medical Department of St Louis University
- LEWIS, DEAN, M D, of Chicago, Ill
- LORINGIER ANDREW STEWART, M D, of Los Angeles, Cal
- LYNCH, JEROME MORLEY, M D, of New York
- MACCAPTY, WM CARPENTER, M D, of Rochester, Minn
- MCKEN TY, F E, M D, F R C S (Eng), of Montreal

PAINFUL SUBCUTANEOUS TUBERCLE

"The painful subcutaneous tubercle is connected with a sensory filament of a cutaneous nerve" and "is usually made up of fibrous tissue" Keen¹¹ classifies them under neuromata and states, "when one grows on a terminal twig of a cutaneous nerve, it gives rise to so much pain, which is often like an electric shock when touched, that it is in consequence "a painful subcutaneous tubercle" Gross¹² also classified them under neuromata, stating that "a few fine examples of neuroma in the form of the painful subcutaneous tubercle of the hand are on record" Treves¹³ and DaCosta¹⁴ classify such tumors under fibromata DaCosta states that "nerve fibrillæ are now known to exist in these tubercles, a fact which was long denied" McFarland¹⁵ says of the painful subcutaneous tubercle, "it consists of fibro-connective tissue, in which some claim to have found nerve filaments"

In two cases, in which I had the specimens examined, nerve filaments were found in each, the pathological report being "neurofibroma" Some surgeons, however, have not taken the same attitude regarding the pathology

Agnew,¹⁶ speaking of such a tumor, said, "though it contains no demonstrative nerve elements, being composed only of fat and connective tissue, it undoubtedly has some relation to adjacent nerves, or, it may be that some of the supposed connective-tissue fibres are amyelinic nerve fibres"

Dupuytren¹⁷ stated that he dissected several such tumors with minute care, and never saw even the smallest nervous filaments adhering to their surfaces

Paget¹⁸ was of the same opinion He was never able to find existing nerve-fibres in the tumor He was disposed to think that most of them are only connected with nerves, as ordinary innocent tumors are, that receive a few fibres in their substance

Because of the fact that the pain of these tumors is so out of proportion to their size, and because he was unable to find nerve structures within the tumor, he believed that the excruciating pain should be assigned to a "functional rather than to an organic disorder of the nerves, to a disorder commencing in the nerves of the part which is the focus of the pain, but transmitted from them to others, which, in the nervous centres, are connected with them"

It cannot be possible that the pain is due purely to altered nerve fibres, as even tumors within nerves are not always exquisitely painful, and, as pointed out by Smith,¹⁹ there is often little or no pain in cases of tumors which have existed in the trunks of nerves

Stengel²⁰ classifies tubercle dolorosa under myomata, stating that "myomata of the skin occur in younger patients, even in childhood, and are generally multiple, and often painful" I believe, however, that these must be another variety of painful tubercles Such tumors have always been described as being benign, but Warren²¹ describes one malignant form of these tubercles in which the lymphatics may become involved, but he cites no cases I was able to find only one case re-

CONTRIBUTORS TO VOLUME LXI

- MARTIN, FRANK, M D, of Baltimore, Md, Professor of Operative Surgery and Clinical Surgery in The University of Maryland
- MORGAN, D, M D, of Montreal
- MOSCHCOWITZ, ALEXIS V, M D, of New York, Professor of Clinical Surgery, Columbia University, Attending Surgeon, Mt Sinai Hospital, Visiting Surgeon, Har Moriah Hospital
- MOULLIN, C MANSELL, F R C S, of London
- O'CONOR, JOHN, M D, of Buenos Ayres, Senior Medical Officer of the British Hospital
- OWEN, H R, M D, of Philadelphia
- PECK, CHARLES H, M D, of New York, Attending Surgeon to the Roosevelt Hospital
- PETREN, GUSTAF, M D, Docent of Surgery at the University of Lund (Sweden)
- PFEIFFER, DAMON B, M D, of Philadelphia
- ROSS, GEORGE R, M D, of Philadelphia
- SHAMBAUGH, GEORGE E, M D, of Chicago, Ill
- SHARPE, NORMAN, M D, of New York
- SIMONS, I H, M D, of Philadelphia
- SKILLERN, PENN G, JR, M D, of Philadelphia, Instructor in Anatomy and Surgery, University of Pennsylvania
- SORESI, A L, M D, of New York
- STAEHLIN, EDWARD, M D, of Newark, N J.
- STANTON, E MACD, M D, of Schenectady, N Y
- STEWART, FRANCIS T, M D, of Philadelphia, Professor of Clinical Surgery in Jefferson Medical College
- STURGIS, MILTON G, M D, of Seattle, Wash
- SWEET, JOSHUA EDWIN, M D, of Philadelphia
- THOMPSON, JAMES E, M D (London), F R C S (Eng), of Galveston, Texas, Professor of Surgery in the University of Texas
- TODD, GEORGE M, M D, of Toledo, Ohio, Surgeon to St Vincent's Hospital
- TOREK, FRANZ, M D, of New York
- TROUT, HUGH H, M D, of Roanoke, Va
- VANDERVEER, ALBERT, M D, of Albany, New York
- VANDERVEER, EDGAR A, M D, of Albany, New York
- WILLSON, H L, M.D, of Philadelphia
- WOOLSEY, WILLIAM CAVAN, M D, of Brooklyn, N Y

PAINFUL SUBCUTANEOUS TUBERCLE

- ¹⁸ McFarland Text-Book on Pathology, p 234
- ¹⁹ Agnew's Surgery, vol iii, p 624
- ¹⁷ Dupuytren Leçons Orales, vol 1
- ¹⁸ Paget *Ibid*
- ¹⁹ Smith *Ibid*
- ²⁰ Stengel Text-Book on Pathology, 1906, p 185
- ¹ Warren On Tumors, p 60
- ²² Dupuytren *Ibid*, p 542
- ²³ American Text-Book of Surgery, p 414
- ²⁴ Gross *Ibid*
- ²⁵ Illus of Disease of Breast, p 84
- ²⁶ Rose and Carliss 1914, p 213

EXTRAPERITONEAL CAUTERY EXCISION OF CARCINOMA

had to be followed into the vesical wall and actually dissected out. The prostatic adenoma was easily enucleated and the stone removed. There was no recurrence of the original growth. The bladder was sutured down to a tube opening and in twelve days the patient was passing all his urine. Since the last operation the patient has been absolutely well and his urine perfectly clear. He has gained about forty pounds.

EXTRAPERITONEAL CAUTERY EXCISION OF CARCINOMA OF BLADDER

DR. BEER presented a man sixty-seven years of age, who in 1912 had the first attack of hæmaturia, and in April, 1914, a second attack, with pain and marked increase in frequency. There had been distinct loss of weight, and his general condition was poor. Cystoscopy and high-frequency treatment April 27, 1914. Cystoscopic examination revealed a rather solid papillary tumor on the right anterior wall, and another at the right ureteral opening. Both tumors were surrounded by thickened, œdematous mucosa. Pieces were excised through the operating cystoscope, from both growths, the pathological report being papillary carcinoma on the tumor of the right wall, and papilloma on the ureteral growth. Owing to the patient's wretched condition it was not deemed justifiable to attempt anything radical, and finally it was decided to open the bladder under local anæsthesia and to burn off the growths, thus temporarily controlling the pain and bleeding. April 29, 1914, after exposing the bladder extraperitoneally, it became evident that the right and anterior walls could be resected with some hope of getting out all the growth except the papilloma at the right ureter. Under chloroform, the bladder was completely freed on the right side from the perivesical tissues, which were apparently not involved, and then the bladder was opened and the surfaces of both growths Paquelinized thoroughly to avoid implants. Then, with the hooked cautery, the excision of the carcinoma was performed and the defect in the bladder closed with a double row of catgut sutures. The bladder was drained suprapubically. Recovery, much to the speaker's surprise, was uneventful, and the patient was discharged in four weeks. Inasmuch as the whole procedure was done more with the hope of palliation than of cure, it was a great surprise to find, on examining the patient on November 5, 1914, that his bladder showed no signs of recurrence, and that he was free from all symptoms.

NOTE.—These cases illustrate the two methods of procedure in excising malignant bladder disease, the intraperitoneal and the extra-

ANNALS *of* SURGERY

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No 1

THE CANCER PROBLEM

By C. MANSELL MOULLIN, F.R.C.S.

OF LONDON

THE cancer problem is with us still. No solution has been found as yet. It is not even known from what direction the solution, for there must be one, will come. Much time and money have been spent in research work. A few new facts have been recorded. Many old ones have been restated in other terms. But so far the frontal attack has failed. Is it possible to make any advance by an attempt upon the flank?

Is there such a thing as cancer? Does cancer really exist as a definite entity, a thing by itself? The cancer of every organ in the body is different from the cancer of every other organ. The appearance is different and the clinical significance is different. Every structure in the body has its own particular kind. The cancer of each individual is as different from the cancer of all other individuals as his constitution is from theirs. Two cases may appear to be exactly alike, but it is impossible from a knowledge of one to predict, with any degree of certainty, what will be the course of the other. Can it be said that there is such a thing as cancer existing by itself? Or is it not, like all other tumors, in reality a form of growth, or rather of growing?

It certainly cannot be separated from other tumors. No definite line can be drawn between cancer and sarcoma on the one hand, nor between cancer and certain varieties of undoubtedly innocent tumors on the other. For convenience of classification innocent tumors are collected into one group and malignant ones into another, but between the two there is a borderland of which no one can say to which side the growths belong nor even whether they do not belong at one time to one side and at another to the other. It is certain that many innocent tumors end by becoming malignant. And what are called malignant tumors differ among themselves no less in the degree of their malignancy. There are no hard and fast lines of division anywhere. It is a mistake to try and form a conception of cancer as something apart from all other tumors. It is one of them, and not to be separated from

BOOK REVIEWS

The last two sections of the second volume take up the surgery of the liver and gall-bladder and the operations upon the pancreas and the spleen.

The entire work constitutes a consideration of operations upon the essential intra-abdominal organs, written in the author's concise manner, and represents an exhaustive exposition of the more important methods of operation which are used at present by the majority of our more prominent surgeons, and will certainly prove a most valuable guide and reference book for those interested in this subject.

JAMES TAFT PILCHER.

SELECTED PAPERS, SURGICAL AND SCIENTIFIC, FROM THE WRITINGS OF
ROSWELL PARK, with a Memoir by Charles G. Stockton, M.D.,
Buffalo, 1914.

This book appeals in a special manner to the ANNALS OF SURGERY, for among the earliest friends gained by the new publication, thirty odd years ago, was a young surgeon of Chicago, who not only contributed the record of his own work to its pages, but also took an active personal interest in bringing it to the attention of his friends in the West. Hardly a year passed during those earlier years without some paper from Dr. Park in the ANNALS OF SURGERY. From that time also dated a personal friendship which lasted throughout the whole life of Dr. Park. We welcome, therefore, with great interest this volume in which are gathered together many of his most important papers, prefaced by a memoir written by his colleague of many years in medical teaching, Dr. Charles G. Stockton.

Dr. Park's life was one of great activity. He had a faculty of doing his work easily. He had the qualities of a man of the world as well as those of a scientist. He was not only a brilliant clinician, but was an adept in the methods of minute research. He combined in himself in an eminent degree the qualifications which would mean success in any department of enterprise. The record of his life is full of stimulus and of encouragement and inspiration to all who are called upon to tread the path of surgical endeavor.

This volume in which the more important of his *opera minora* are gathered together presents a most interesting record and mirror of his work. Opposite its title page has been placed an excellent portrait which shows the lineaments of the man. The book is an ideal record of an ideal surgeon.

LEWIS STEPHEN PILCHER

them. The clinical features so often regarded as distinctive, such as the power of dissemination, are in no way peculiar to it. They are merely an exaggeration of powers that can be exercised by many embryonic cells.

The starting point of all tumors, cancerous or not, is a bud growing out from cells which appear to be normal. Until that moment the development of these cells seems to be following the ordinary lines. There is no apparent difference between them and those that preceded them or those that lie around. Suddenly their development stops. Whatever the point it has reached, it does not advance one step farther. But their growth continues, with all the more vigor because now no energy is being consumed in raising the cells to a higher plane. Their increase is controlled by nothing but the supply of food and the pressure of the structures around. The result is a shapeless, formless mass of cells, resembling their parent in a general way, never advancing to a higher plane of development, never doing any work, but growing without ceasing—in other words, a tumor.

The kind of tumor depends partly upon the kind of cell, partly upon the stage in development it had reached at the moment progress was arrested. If the cell has already attained a high degree of specialization, the tumor cells are highly specialized too. Their rate of increase is slow. Surrounding structures are pushed to one side without being invaded, and the tumor is called innocent. If, on the other hand, the arrest of development takes place while the parent cell is still in the embryonic period of life, with all the vigor of youth unimpaired, the cells retain their embryonic character, growth is rapid, and the tumor is malignant. The cells, for example, are capable of transplantation, travelling in the lymphatics or in the blood stream, along the lines of least resistance. Many of them perish in their wanderings, it is true, for now they are invaders and attacked as such, but some survive where the conditions are favorable, and these become the starting point for similar tumors.

The problem, therefore, of the origin of cancer and other tumors turns upon the relation that exists between growth and development. Growth, increase in size, and then increase in number, is a property inherent in all tissue-cells, so long as they are living. It is born in them with their birth, lives with them throughout their lives, and dies with them when they die. So long as the conditions are favorable, it knows no bounds or limits. Development is the outcome of the inheritance from ages past of all the countless variations that were acquired in

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days gone by and have been transmitted from generation to generation. It is dependent upon heredity, and it is the force that directs and controls growth. If its power fails, no matter what stage it may have reached, growth at once asserts itself with all the energy it has left, and the cells increase and multiply until they form a tumor.

Failure of this power may be due to many causes. Age is one. As years advance the energy that lies behind development becomes feeble, and tumors of all kinds become more numerous. In infancy and childhood they are comparatively rare. In adult life they become more common. In old age they may be present in hundreds. This is no less true of organs than it is of individuals. Some organs grow old long before others, and these are especially prone to become the seat of tumors. Disuse is another. It is notorious that organs which, from not being used as they should be, fail to attain the full perfection of development, are peculiarly liable to cancer. Injuries, especially those which by constant repetition interfere with the building up of the tissues, are often followed by tumors. A single blow is sufficient if the structure affected is in a state of active development. Scars, particularly those which are poorly developed, because they have remained unhealed for some considerable time, or have broken down again after having healed, are peculiarly liable to become the seat of cancer. Organs that for other reasons remain immature and fail to develop are far more subject to malignant disease than those which attain their full proportions at the proper season. Everywhere that there is increased liability to the formation of tumors and of cancer, there is either weakening or actual arrest of the force that lies behind development.

There is the same increased liability if, while development continues at or near its normal level, growth is unduly stimulated so as to upset the balance between them. Tumors of various kinds are nearly always present in organs that have become overgrown from other than physiological causes, and also in those cases in which limbs or other portions of the body have attained disproportionate dimensions owing to something that has happened in early embryonic life.

The increased liability to the formation of tumors is no less marked if the course of development is checked by artificial means. Certain forms of cancer as well as other tumors can be produced almost at will by means of chemical or physical agents which impair the development of the tissues and prevent them from attaining full structural perfection. One of the best examples is the skin, for here the changes can be seen. The late Sir J. Hutchinson long since pointed out that the prolonged

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internal administration of arsenic was liable to affect the nutrition and the structure of the skin, causing it to become harsh and dry, and that a form of cancer not uncommonly followed. The action of soot in causing cancer is well known, but it is often overlooked that there is a long preliminary stage in which the skin becomes cracked and dry, and covered over with warts. Tar has a somewhat similar effect, only the form of growth is not quite the same. The influence of repeated exposure to the Röntgen rays upon the skin—the alteration in its texture, the production of warts, and then of cancer—is only too well known. And the great frequency of rodent ulcer in certain parts of Australia has been attributed, probably correctly, to the atmospheric conditions that prevail there, and the effect they have upon the tissue changes in the skin. But it is not confined to the skin. Similar examples occur in connection with other organs. Workers in aniline colors, for instance, are peculiarly prone to the occurrence of tumors (including cancer) in the excretory organs, and those who are employed in cobalt mines to similar growths in the lungs, only because of the situation of these organs we have no evidence of preliminary structural changes in the tissues.

These effects are produced by foreign agents, introduced or acting from without. Whether similar effects can be produced by substances that are manufactured in the body itself is not known. We have too little knowledge as yet of the intimate chemical changes that take place in the tissues to form any opinion.

The supposed inheritance of certain kinds of tumors and of cancer is only to be explained in this way. Tumors, like other acquired features, are not inherited, yet there is no doubt that some families are much more prone to the formation of tumors and of particular kinds of tumor, or at particular times of life, than others. The power of hereditary transmission, upon which development depends, varies in strength in different families. In some special features are handed down unchanged from generation to generation, while in others they can scarcely be traced. So it is with the tissues. In some the power of heredity is so strong that the tissues maintain throughout life the full perfection of their development, and growth is never allowed undue license. In others the power is weaker, and liable to fail. Then if, because of some injury or irritation, there is a great production of young, rapidly-growing cells, development is checked, and growth at once becomes rampant. It is not the tumors that are inherited, but the strength of the force that compels development and so controls growth. This may fail in several members of the same family for generation after generation, just as the

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transmission of special features may fail, and lead to those members suffering from the same form of tumor at perhaps the same time of life

There are two factors, therefore, working together in the production of cancer and other tumors. One is arrest, or weakening, of the power of development, due to failure in heredity, age, disuse, injury, the interference of chemical or physical agents, or other causes. The other is local irritation leading to increased cell-growth. The effect of their combined action is the production of masses of cells which never attain their perfect form and which increase with a rapidity that depends upon the stage at which their development was stopped, and upon the supply of food.

Cancer and other tumors will never disappear. There is indeed reason to think that they may become more common as civilization advances. The proportion of aged people, who are the most susceptible, will continue to increase, and it is to be feared that artificial modes of living may still further weaken the hereditary force of development that guides and controls the innate power of growth. On the other hand, a clearer conception of the causes that lead to the production of cancer, a better knowledge of the chemical changes that take place in the tissues, and the avoidance of local causes of irritation may do much to produce the opposite effect.

B

INFLUENCE OF INHALATION ANÆSTHESIA ON THE ACIDITY OF THE BLOOD AS DETERMINED BY ESTIMATION OF H-ION CONCENTRATION*

BY GEORGE W CRILE, M D.

OF CLEVELAND, OHIO

THE energy of the body which in different ways is derived from the environment is temporarily stored in different organs and tissues until, in response to some adequate stimulus, it is transformed into heat or motion. Prominent among the products of this transformation of latent into kinetic energy are acids. We may say that every motion, every emotion, every injury, every physical exertion, every degree of fever, every reaction to infection or to auto-intoxication, every respiratory movement, every heart beat produces acid by-products. Under normal conditions these acids are neutralized—into harmless compounds which are eliminated by the kidney—so that under normal conditions the body tissues and fluids are slightly alkaline. If every activity of the body produces acidity in a greater or less degree, it is vitally necessary for the body to maintain a large margin of safety against acidosis by the presence of alkaline salts and bases, which are derived from food. Experiments have shown that for the maintenance of its normal state of alkalinity, the body is dependent mainly upon the liver, and perhaps secondarily upon the suprarenals and the thyroid. When the liver is excised the blood soon loses its slight alkalinity and in a few hours becomes acid. When the suprarenals are excised the alkalinity of the blood is maintained for a longer period—perhaps twice as long—but it then becomes acid, and in each case the acidity of the blood is the close precursor of death. The excision of no other organ in the body produces this tendency to an immediate increase in acidity. Whether the increased acidity in these instances be due to dissolution, or whether dissolution be due to acidity, or whether there be no causal relation between increased acidity and dissolution has not been definitely determined.

We cannot dwell here upon other experimental observations which show the relative activities of the liver and the suprarenals in this neutralizing process, nor the evidence that the liver and the suprarenals are directly controlled by the brain, which also controls the transformation of energy, which in turn, as we have already stated, always pro-

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duces acidity, we will merely recapitulate by saying that the harder the body is driven by any stimulus, the more rapidly will latent energy be transformed into kinetic energy. The more rapid the transformation of energy, the more rapid the production of acid. The greater the production of acid, the greater also the strain upon the power of neutralization possessed by the liver and the suprarenals, and the greater the drain upon the body's store of alkalies and bases. When the liver and the suprarenals are overtaxed and the alkalies and bases are exhausted, the state of acidosis is reached.

Clinically it has long been recognized that when a patient is in a state of exhaustion resulting from infection, from injury, from shock, from starvation, from hemorrhage—from any cause whatsoever—he may never recover consciousness after the administration of a general anæsthetic. In a foreign reference, which I cannot now recall, it is shown that dogs first starved then anæsthetized inevitably die. Clinicians know well how unsafe it is to give a general anæsthetic of any kind to a patient on the verge of acidosis. A patient with chronic vomiting, with an acetone odor of the breath, with peculiarly pink lips and dry tongue and mouth may never regain consciousness after inhalation anæsthesia. The aged not infrequently die after even short inhalation anæsthesia.

Why do not these patients recover? If the patient have the power of consciousness before the anæsthetic is administered what happens during the anæsthesia to make it impossible for the patient to regain consciousness?

We have already referred to the acid-producing power of stimuli. Shall we conclude therefore that the trauma of the operation alone may have pushed beyond the margin of safety the neutralizing powers of the body already taxed by preexisting conditions, or is the anæsthetic itself a factor in producing the fatal result?

To answer this question Dr. Menten, in my laboratory, made for me observations on the H-ion concentration of the blood under various conditions—the H-ion concentration being an index of the acidity of the blood.

H-ion concentration tests were made after the application of many kinds of stimuli, the results of which confirmed the postulate which we have already stated,—that acidity is the result of the activation of the body by an adequate stimulus. The blood was then tested to determine the H-ion concentration in ether anæsthesia, in nitrous oxide anæsthesia, and after the administration of alcohol and of morphine. Both ether and nitrous oxide produced a marked immediate increase in the

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H-ion concentration, that is, both caused an increased acidity in the blood during anæsthesia. After coming out from the anæsthetic this acidity was neutralized by the animal in about thirty minutes. This result gave us a clue to the tendency to acidosis and to death under anæsthesia in weak and emaciated patients. The increased acidity produced by the anæsthesia was sufficient to overcome the already narrow margin of safety. That acid intoxication *follows* the administration of ether and chloroform has been noted by many observers—the acidity being evidenced by the early appearance in the urine of acetone and later diacetic acid. It has also been noted, as one writer states, that the “starvation preceding and following the operation is also a factor of considerable importance.”

Our experiments have shown, however, that the increased acidity actually develops *during the anæsthesia itself*, sometimes to a fatal degree, and that a starved condition is not only of “considerable” but of *prime* importance, since it means that the acid-neutralizing power of the liver has been surely impaired—possibly lost.

Two more important clues were obtained from the result of the H-ion concentration tests after the administration of morphine and of alcohol. Alcohol caused acidity, the acidity not being so marked, however, as that produced by the anæsthetics. The H-ion concentration was not altered by morphine no matter how large the dose. *When the administration of morphine preceded the induction of anæsthesia then a smaller amount of the anæsthetic was required to produce complete anæsthesia, and the H-ion concentration test showed that the acidity was correspondingly less than in anæsthetized animals which had not received the preliminary dose of morphia.* The preliminary dose of morphia not only lessened the degree of acidity produced by the anæsthetic, but it in no way interfered with the return of the blood to its normal alkalinity, on the contrary—and the following observation is of great significance—*if morphine was given after acidity had been produced by the anæsthetic, it prolonged the period of neutralization and, if given in large doses, prevented the animal from overcoming the acidosis.* That is, it would appear that morphine controls the mechanism which governs the neutralization or alkalization of the blood.

These H-ion concentration or acidity tests of the blood have therefore given us the clue, and an invaluable clue, to the treatment of patients with mild acidosis or in whom acidosis is threatened. Since in every case the presence of diseased conditions is undoubtedly producing a mild acidosis, needlessly long anæsthesia is to be avoided, as the increased acidity produced by the anæsthetic will diminish the patient's

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INFLUENCE OF ANÆSTHESIA ON ACIDITY OF BLOOD

vitality The degree of acidosis seems to be proportional not only to the length but to the depth of the anæsthesia The lightest possible anæsthesia should be maintained therefore *With starved patients, with patients whose vitality is at a low ebb, in whom acidosis is already markedly present, the inhalation anæsthetic may be absolutely contra-indicated* If an operation is mandatory it may be performed under local anæsthesia, or in twilight anæsthesia produced by the gentlest administration of nitrous oxide oxygen

Although both the preoperative and the postoperative use of morphine is of great value in certain cases, in these cases of existing or threatened acidosis its use is contra-indicated, since it interferes with or prevents the neutralization of acidity in the blood, but bromides per rectum may be safely given to diminish the preoperative psychic strain The preoperative and postoperative administration of sodium bicarbonate and glucose is of value also

To recapitulate—the ideal treatment for the class of patients we have been considering, those handicapped by exhaustion in whom acidosis is present or is threatened, is

- 1 The preoperative administration of sodium bicarbonate and glucose and of bromides per rectum

- 2 Twilight anæsthesia

- 3 Complete anociation by the use of local anæsthetics and gentle manipulations so that but a small amount of the anæsthetic is needed

- 4 In bad risks as rapid a technic as is consistent with good work, that the period of anæsthesia may be as short as possible

- 5 The avoidance of worry, fear, and injury—since these factors also produce increased acidity

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CONTRIBUTION TO THE STUDY OF THE STRUCTURE OF ENCEPHALOCYSTOCELE

BY CARLO SAVINI, M D
OF NEW YORK CITY

RECENTLY I have had under my care a case of encephalocystocele, and I have made microscopical examination of the specimen. The following is a report of the case, and an explanation of the microscopical findings.

A female child, fifteen days old, of Italian parentage, was admitted to the Washington Square Hospital July 12, 1914. The mother said that the child was born with a "lump" about the size of a hen's egg on the back of the head, and that this "lump" gradually increased in size.

The child would cry every time the "lump" was in any way manipulated or even touched, and it became necessary to provide a special soft pillow upon which to rest the child's head.

On a general examination, the child was found to be perfectly normal and well developed, except for the tumor. The swelling was almost twice the size of the head itself, in shape more or less reniform, and was connected to the head posteriorly by a large pedicle attached to the occipital bone, at and around the site of the external occipital protuberance. The longitudinal circumference measured eighteen inches, the transverse twelve inches, and the oblique sixteen and one-half inches.

The portion of the skin near the pedicle was covered with hair, the appearance of the tumor was translucent, especially in the area of greater convexity. A small rounded area of the skin, about one inch in diameter, was inflamed and necrotic, the rest of the skin was reddened.

Pressure exerted over the tumor was not accompanied by any reduction of the size of the tumor, or by any evident alteration in the circulation or respiration of the child, and no impulse could be elicited in the tumor when the child cried. The diagnosis of encephalocystocele was made, and a surgical operation deemed necessary.

The skin over the head of the child and over the tumor was shaved, and a boric acid dressing was applied over night to reduce the inflammation of the skin. On the following morning (July 13, 1914), at eight o'clock, the child was operated upon.

The skin was painted with tincture of iodine, and a trochar

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inserted into the tumor to evacuate its contents. The fluid removed measured 1000 c.c., and was serosanguinous in character. Two large clamps covered with rubber tubing were now loosely applied to the pedicle of the tumor, so as to avoid any unnecessary or great loss of blood. Two transverse skin incisions were made to insure the formation of a superior and inferior flap. The skin was dissected around the tumor, and a large sac was found in the cavity. This sac was dissected free, then opened. It was found to communicate with the cranial cavity through a small opening about one-half inch in diameter, slightly to the right and at the level of the external occipital protuberance. A strip of brainy tissue about two inches in length protruded into the sac from the opening, and was adherent to the sac walls. That portion of the brain tissue, which was nearest to the opening and easily reducible, was reduced into the cranium, and the sac, together with some brain tissue adherent, was removed. The connective tissue around the opening was sutured. A periosteal flap was dissected and sutured over this. The skin was sewed with a continuous suture of silk. A dry dressing and compression was applied. No anæsthesia was used for the operation.

At the completion of the operation, the child suffered with symptoms of shock, so was given saline solution by rectum while still in the operating room. One hour after the operation, the child was able to nurse.

After the operation, the general condition of the little patient was good, and she was able to nurse regularly up to July 15. Then for two days the temperature arose to 101.8° by rectum, and she had tonic contractions of the right foot and hand. These have been the only symptoms we could attribute to a lesion of the central nervous system. Otherwise during the time of her stay in the hospital the child was perfectly normal, and we could not discover any pathological symptoms. From July 17, the child improved, and her appetite increased so that, although nursed by the mother, it was necessary to provide also a feeding bottle to appease her hunger.

July 20, the stitches were removed, and except for a small stitch abscess, the wound was perfectly normal.

The child was discharged from the hospital on July 26, 1914, apparently perfectly well.

Examination of the Specimen After the Operation—Quantity of fluid removed, 1000 c.c., appearance of the fluid, bloody, specific gravity, 1012, reaction, alkaline, albumen present in great quantity, sugar absent.

A great quantity of red blood corpuscles is found in the microscopical examination of the sediment.

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- DRUMMOND, HAMILTON. Inversion of Meckel's diverticulum, lv, 404
- Ductless glands, the relation of the, to surgery, lmi, 545, 570

The sac is formed of three membranes easily detachable one from the other, and fused together in the vicinity of the ring, which marks the opening of the sac into the cranial cavity. The external membrane is very little vascularized and of white color. The middle membrane presents a net of numerous large and small vessels, and the internal membrane is very friable. All around the opening leading into the cranial cavity, brainy substance is found attached to the sac. The skin covering the sac at the level of the ring continues with the scalp, and, macroscopically examined, does not show any difference from the common scalp. Part of the specimen was fixed and kept in a 10 per cent solution of formalin, part of it was fixed with Carnoy's fluid and then kept in alcohol, and part was fixed and kept in alcohol. The pieces were imbedded in celloidin and colored with boric carmin, with hæmatoxylin and eosin, and with toluidin blue. Sections were made of the skin covering the tumor, of the sac in the vicinity of the ring, and of the brainy substance.

Sections of the Skin—The epidermis is perfectly normal, but the corium has no papillary stratum.

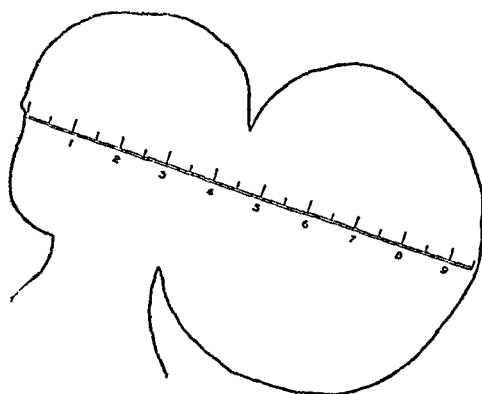


FIG. 3.—Outline of the head and of the tumor taken directly from the patient (scale in inches)

Sections of the Sac—The section of the sac shows that the external membrane is formed of connective tissue, with few small vessels. The middle membrane is formed almost exclusively of large vessels, and the internal membrane is formed of amorphous tissue.

The section of the sac, in the vicinity of its pedicle near its opening into the cranial cavity, shows presence of cerebellar tissue.

The first examination, with a low power objective (Fig. 4), gives the impression that the cerebellar tissue is normal and distinguished by its characteristic lobules, but the examination with a high power objective shows that each lobule is surrounded by a great quantity of blood-vessels, and that the molecular layer instead of being external to the granular layer is internal to it, and the white matter is external to this granular layer (Figs. 5 and 6). In other words, it seems as if each lobule of the cerebellum had been turned inside out like the fingers of a glove, in such a way, that the external stratum of each lobule is brought inside, and the internal part brought outside. In proof of this we find that the cells of Purkinje are found in the internal part of the lobules, while in the substance outside of the granular layer we do not find any ganglionar cells.

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FIG 1 —Condition of the patient before operation



FIG 2 —Two weeks after operat on

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- Gas cysts of the, *liii*, 576, *lvii*, 811
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- Rupture of, in a child, *lviii*, 686
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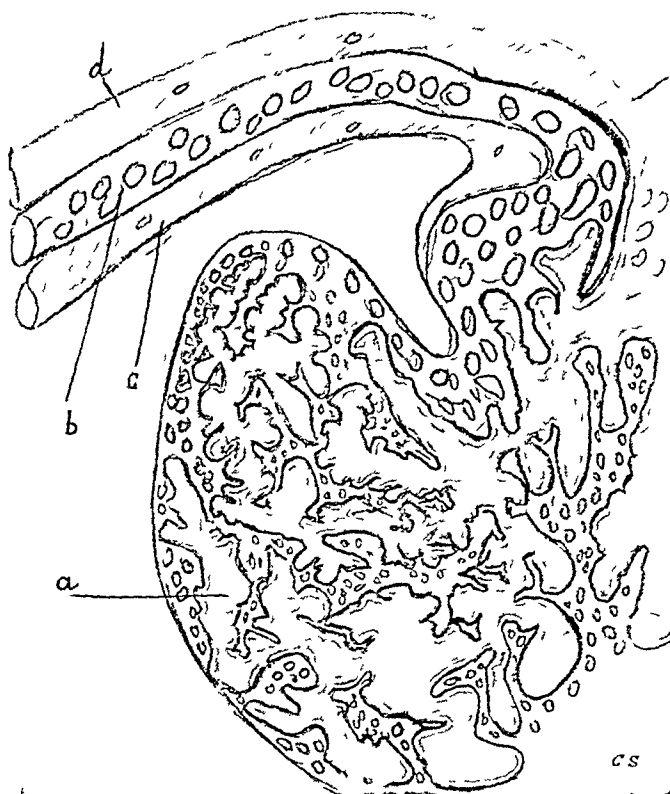


FIG 4 —View of the section of the sac in the vicinity of its opening in the cranial cavity. *a* lobules of the cerebellar substance, *b* middle membrane of the sac, *c* internal membrane of the sac, *d*, external membrane of the sac (Oc 2 Ob 32 mm)

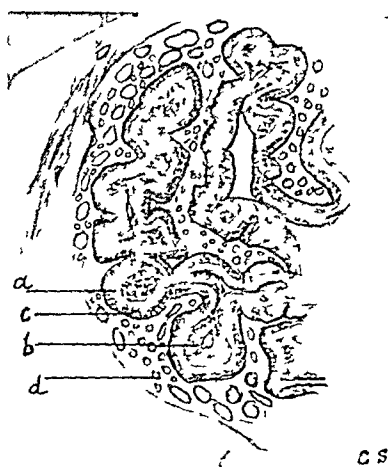


FIG 5 —View of a lobule of cerebellar substance. *a* granular layer, *b* molecular layer, *c*, white substance, *d* vascular membrane (Oc 2 Ob 3 Reichert)

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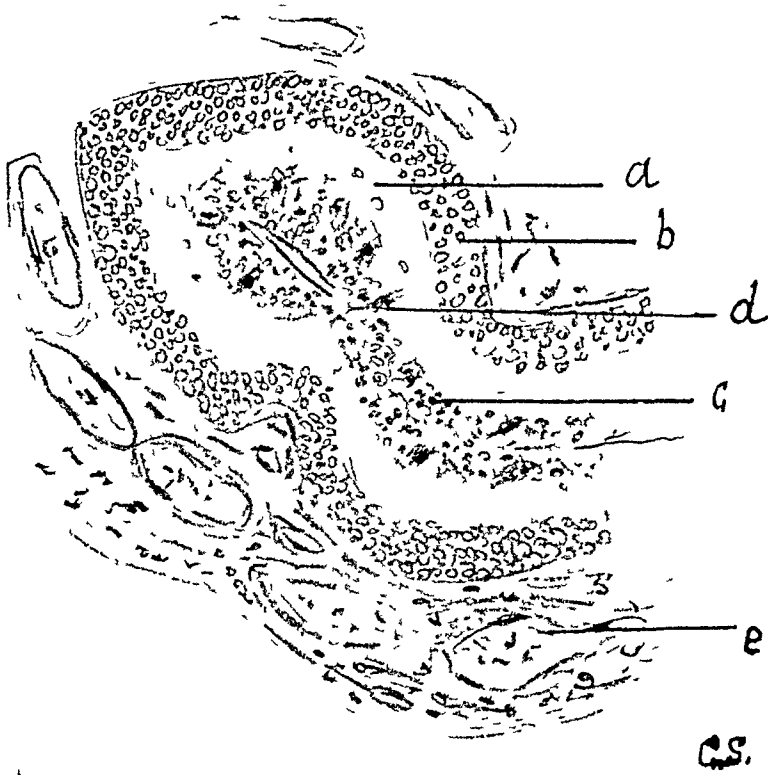


FIG 6 —Enlarged view of a lamella *a* granular layer, *b*, white cerebellar substance, *c*, molecular layer, *d*, cellules of Purkinje, *e* blood-vessels (Oc 2, Ob 4 mm)

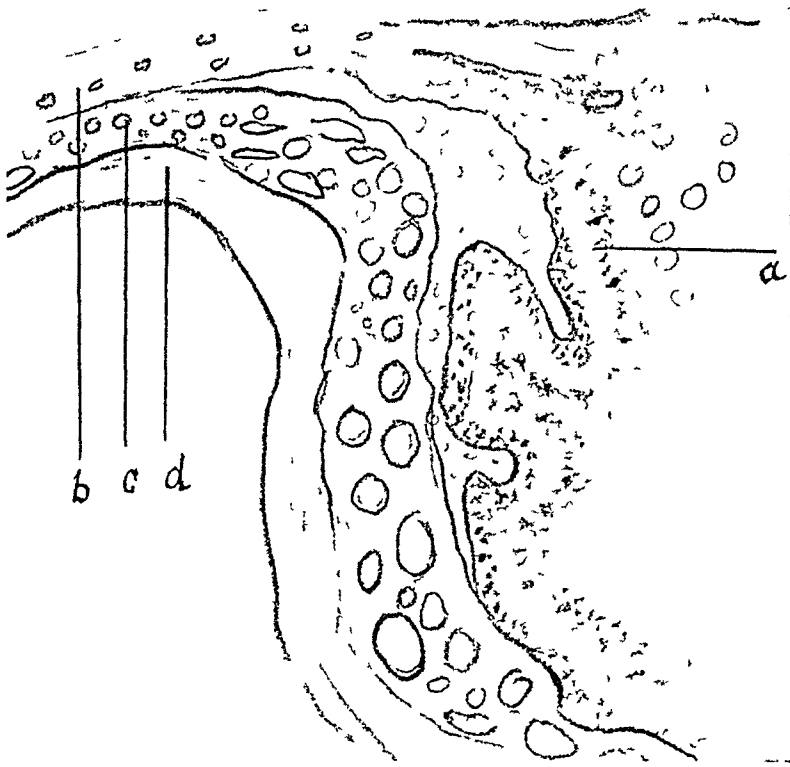


FIG 7 —View of the termination of the cerebellar substance and its attachment to the external membrane of the sac *a* cerebellar substance (the three layers of the cortex), *b* external membrane of the sac, *c*, middle membrane of the sac, *d*, internal membrane of the sac (Oc 2, Ob 3 Reichert)

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FIG 8 —Photographic view of the preparation of Fig 7

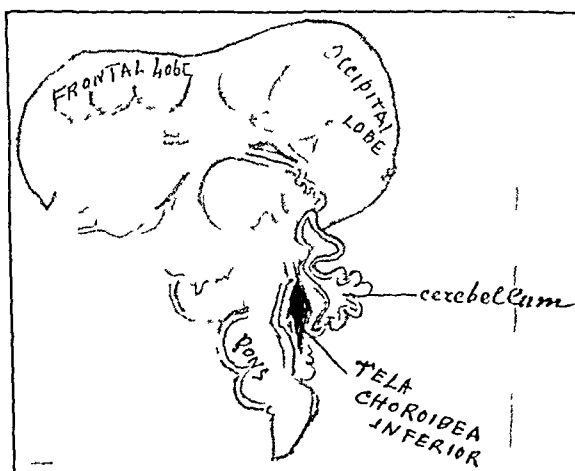


FIG 9 —Encephalus of human embryo three and one-half months old (From Poirier and Charpy modified)

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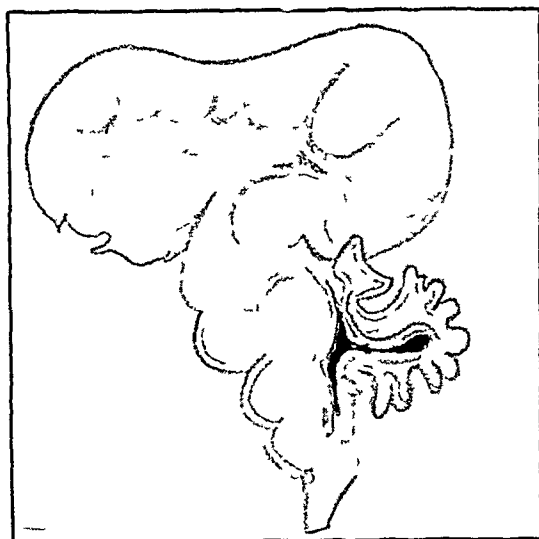


FIG 10 —Schema from Fig 9, showing the effect of enlargement of the tela chorioidea inferior

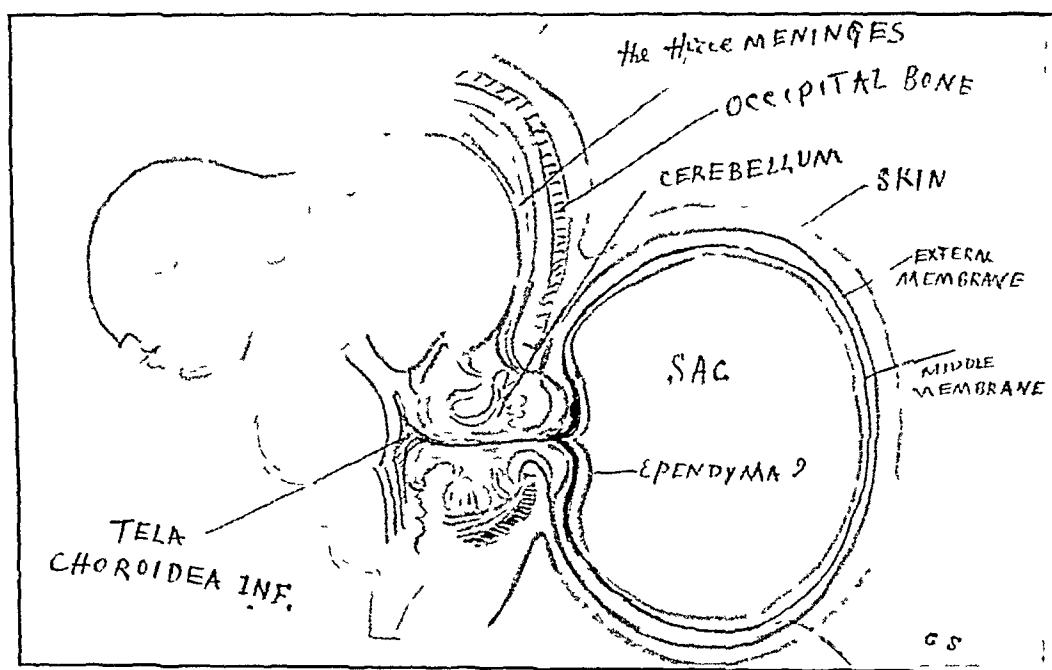


FIG 11 —Schema from Fig 9, showing the perforation of cerebellum and the formation of the extracranial sac

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STRUCTURE OF ENCEPHALOCYSTOCELE

To understand this eversion it is enough to presume that for some reason the central limb of the white matter in the centre of the lobule has been split, and the two parts of the cortex turned to describe an arch of about 300°

Following the three layers of the cerebellar cortex up to the walls of the sac, I found them attached to the internal part of the external membrane of the sac, and I noticed that these layers, as they approach the walls of the sac, become thinner and thinner, and finally disappear. The first to disappear is the granular layer. Soon after the molecular layer cannot be found, and the white matter is the last to disappear, spreading out into a very fine covering on the internal surface of the external membrane of the sac (Figs 7 and 8). The cells of Purkinje are not to be found, after the granular layer has disappeared.

The vascular membrane that surrounds each lobule covers all the cerebellar substance of the specimen, and when this substance has disappeared, this vascular membrane continues to cover the external membrane, and thus forms the middle membrane of the sac.

Inside of this vascular membrane, I found some very delicate fibrous tissue which continues to form the innermost membrane of the sac.

In conclusion, the external membrane of the sac is to be considered as the extension, outside of the cranial cavity, of the three meninges of the cerebellum, the dura mater, arachnoid, and pia mater fused together.

The middle membrane comes from the interior of the cerebellum, most probably from the tela chorioidea inferior of the fourth ventricle, or from the choroid plexus of the third ventricle.

The inner membrane is more difficult to explain, probably it is a derivative of the ependymal cells.

SURGICAL, PHYSIOLOGICAL AND ANATOMICOPATHOLOGICAL CONSIDERATIONS

Surgical Observations—When an infant affected with encephalocystocele is brought to a surgeon, it is advisable, as a general rule, to wait until the child is older to perform the operation. This rule should be imperative when the life of the patient is compatible with the lesion, but it could not be followed in my case, as the tumor was already very large and increasing daily, and presented an area of necrosis in the skin which might endanger the life of the patient by causing septic meningitis.

The formation of two flaps, one superior, one inferior, has many advantages over two lateral flaps, because the line of suture is brought up in the skull and can be better protected by the dressing, the flaps must be liberally large on account of the retraction of the skin and the increasing size of the head.

In regard to the brainy substance found in the sac, it is advisable to reduce only that portion of the brain which requires little manipulation to do so. The rest ought to be removed with the sac.

A sharp excision is less dangerous than any mangling of such a delicate structure. After the excision of the sac, the opening should be closed with a fine suture, in order to prevent necrosis which may occur after ligation of the pedicle.

I think too much importance has been given to the formation of a periosteal flap. Such a flap is difficult to dissect and once sutured it is not sufficiently resistant. It is quite enough to draw together the connective tissue found around the ring with two or three stitches.

Physiological Considerations—Although a part of the right lobe of the cerebellum was removed, at present the only symptoms that could be attributed to the operation were the tonic contractions of the right superior and inferior limbs first noticed three days after the operation. When a total or partial excision of the cerebellum is made experimentally (L. Luciani), the animal shows two orders of symptoms. Some

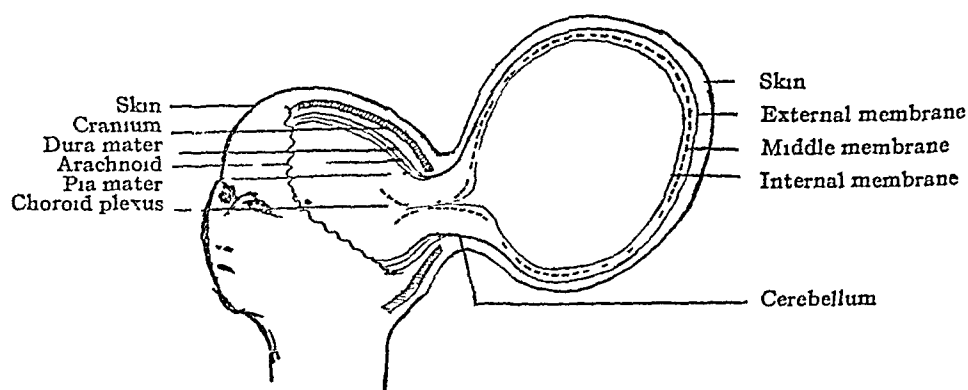


FIG 12—Schema of the conditions at birth

appear soon after the operation and are symptoms of irritation. Other symptoms of cerebellar deficiency, or inhibitory, appear later on and are characterized by the so-called cerebellar ataxy. The tonic contractions observed in my patient on the third day after the operation were evidently symptoms of irritation. My patient is at present too young to permit the observation of any symptoms of cerebellar ataxy. This patient will be an interesting subject to be studied later, as surgical excision of cerebellar substance in the living human being is a very rare occurrence.

Anatomicopathological Observations—From the microscopical findings in this case, it can be presumed that the disease is caused by an active process of some internal structure of the brain. The middle membrane of the sac is formed by a vascular structure, which covers the part of the cerebellum attached to the sac, and evidently comes from the internal parts of the brain. The only explanation of this fact, is

STRUCTURE OF ENCEPHALOCYSTOCELE

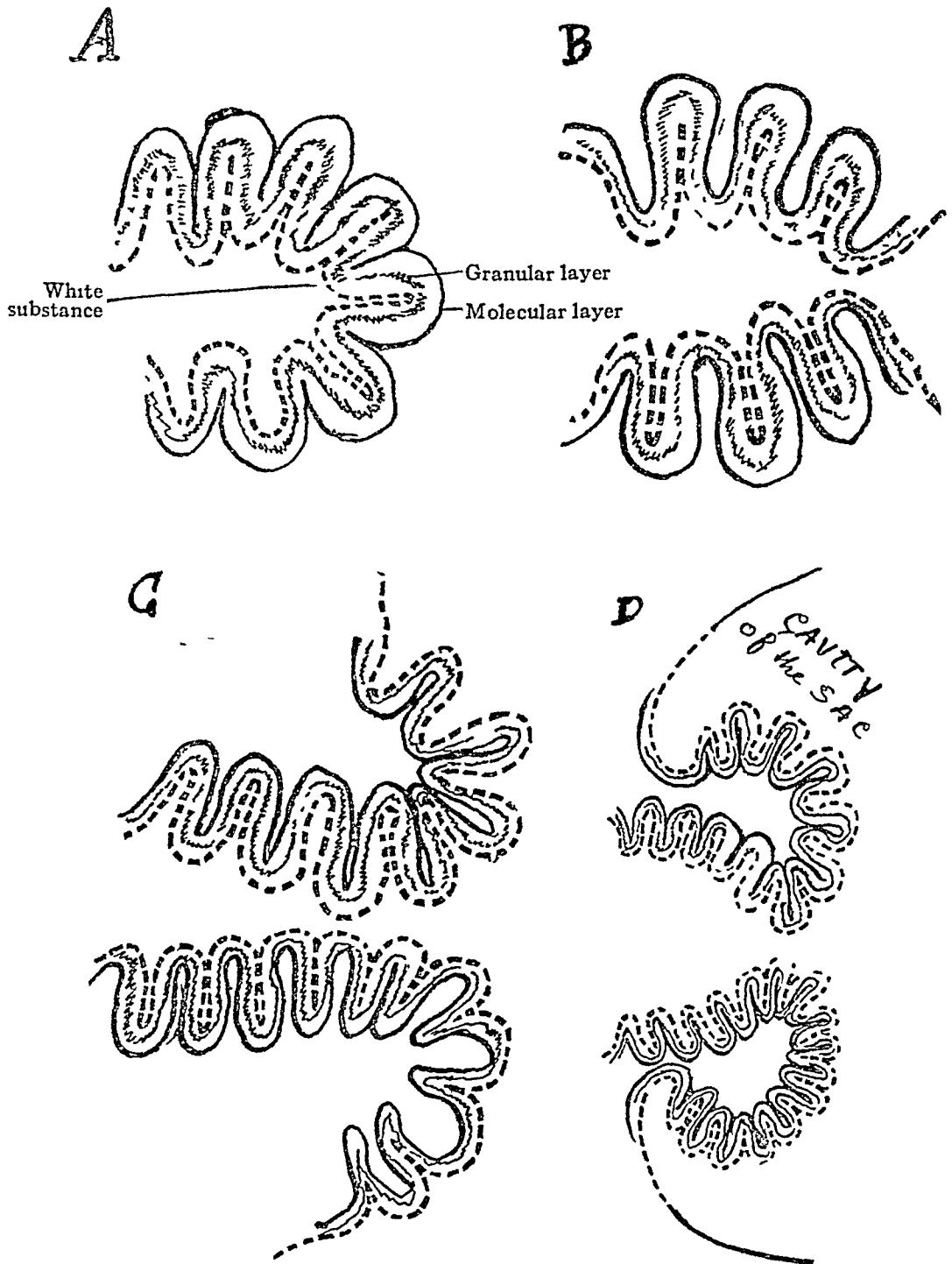


FIG 13—Schema to show the extroflexion of the cerebellar cortex in the sac. A, normal cerebellar cortex. The internal or white substance is shown by dashes. B and C, different degree of eversion of the cortex. D, the eversion completed.

to consider this vascular membrane as a prolongation of and dependence of some vascular membrane of the brain, as, for instance, of the tela chorioidea inferior of the fourth ventricle or of the choroid plexus of the third ventricle

If we remember the embryological development of the tela chorioidea and of the choroid plexus in the brain (Figs 9, 10 and 11) and the position of the cerebellum in relation with these structures, we can easily see that in consequence of a pathological hypertrophy of this plexus, the cerebellar cortex may be expanded, and pushed through an accidental opening found in the skull. When the resistance of the cerebellum is overcome, the choroid plexus may protrude through the cerebellum (Fig 12) and expand under the skin, forming one of the layers of the sac.

The alterations in the circulation of the middle membrane is the cause of the exudation of the great quantity of fluid found in the sac.

The cerebellar substance, lacerated and pushed aside by the invasion of the hypertrophic plexus, adheres to the walls of the sac and, continuing its development, rolls up, and as a result it extroflexes itself (Fig 13). In this way the internal part of the cortex is brought externally, and this explains the peculiar appearance of the sections of the lobules of the cerebellum.

OBSERVATIONS ON CEREBRAL SURGERY*

BY JAMES H. KENYON, M.D.
OF NEW YORK

THIS article is a brief account of the author's personal experience in cerebral surgery during the last fourteen years, and has for its basis the technic developed by the late Dr Frank Hartley and himself, an account of which was published in the ANNALS OF SURGERY, April, 1907

This technic has stood the test of repeated use for many years in the hands of numerous surgeons

This will be described with the modifications and changes suggested by the varied conditions arising during its more extended use The author, either as operator or as assistant, has had an opportunity in 160 cerebral operations of various characters on every region of the head to note the efficiency and safety of this technic No accidents or complications have been observed

As this paper is limited to a description of the operative technic only, no extended report of cases will be included

The following table shows the regions exposed and the intracranial conditions found in the 160 cases

TABULATED STATEMENT OF CASES OF CEREBRAL SURGERY STUDIED

Region exposed	Tumors	Abscess	Cyst	Exploratory operation	Fracture	Compound depressed fracture	Old fracture and scar tissue	Extradural hemorrhage	Subdural hemorrhage	Laceration of brain and dura	Meningitis	Leptomeningitis	Hydrocephalus	Microcephalus	Jacksonian epilepsy	Total
Frontal	1	1	1	1		2										6
Vertex	1					1										2
Lateral	16	2	1	9	4	2	4	2	2	1		5		2	4	54
Parietal	1		2	2		2	4						5			16
Occipital	3					2		1	1	2						9
Cerebellum	7			2												9
Both lobes of cerebrum and cerebellum											2					2
Single flap																
Total	29	3	4	14	4	9	8	3	3	3	2	5	5	2	4	98

Gasserian ganglion—excision and division of sensory root

62

Total cases

160

Celluloid Plates—Regions Frontal, 2, lateral, 7, parietal, 4, occipital, 4 Total, 17

The aim has been to devise a method of procedure in operations upon the head which will lessen the risk and difficulties attendant upon the

* Read before the New York Surgical Society, October 14, 1914

peculiar anatomical combination of vascularity, dense bone and delicate brain tissue To attain this end special attention must be directed to the anæsthesia, hæmostasis and gentleness of manipulation. Also to a rapid and certain method of exposure, equally quick and efficient regardless of size of opening, thickness or hardness of the skull It is also desirable that this exposure be made in such a manner that the opening may be accurately closed and the normal protective cranium restored Perhaps the greatest emphasis should be placed upon the gentleness of manipulation, particularly in dealing with the lesion after the skull is opened

METHODS OF OPENING THE SKULL—The various different methods of opening the skull are familiar to all Each has its advantages and disadvantages and each operator has some particular one that, for him at least, is satisfactory A few remarks on these different methods follow

Chisels, gouges and mallet have been used to make small openings and large osteoplastic flaps, but the objections, pounding and the danger of injuring the dura and brain, render them undesirable

Trephine or burr with a subsequent enlargement of the opening with the rongeur is satisfactory where the exposure is not extensive and the bone is not to be replaced The disadvantages are the time and physical effort required to make a sufficiently large opening, particularly when the bone is thick and dense and the surgeon's hand is more or less fatigued and not in the best condition for the delicate intracranial part of the operation

Trephine or burr may be used to make several openings outlining the margins of an osteoplastic flap A *Gigli saw*, introduced from one opening to another, cuts the intervening bone from within outward either at right angles or at a bevel This is a simple and efficient method, but thick, dense bone will make the process slow and tedious, with the probable breakage of several saws and the subsequent trouble of passing another Adherent dura, or dura which has been punctured while making the holes or passing the saw, will be cut or torn by the saw and the cortex possibly damaged and troublesome hemorrhage ensue

Trephine or burr may be used to make one or more holes at one corner of the osteoplastic flap or around its margin These holes are then united by cutting the intervening bone with one of the various slot-cutting forceps, as DeVilbiss, Dahlgren, or Hudson To ensure a better fitting flap about one inch of bone between the two holes opposite the hinge or broken edge is cut with a *Gigli saw* on a bevel

This method is very quick, simple and satisfactory, provided the

bone is not thick or hard and the dura not adherent, in which case it is slow and tedious. The slot is rather wide and does not furnish the best fitting flap. The cutting blade has snapped off and later been found embedded in the brain. The self-locking burrs often used to make the holes are quick cutting and lock just as the inner table is being penetrated, so that further turning is difficult or impossible.

However, on very thin bone this safety-locking feature cannot always be depended upon, and sudden, complete penetration of one to two inches into the brain substance has occurred with unfortunate termination.

Fraises, of which there are a number, Sudeck, Doyen, and Ciyer, may be used. These are operated by power through a flexible shaft or belt and pulley and are fitted either with a button on the tip or a shoe in which the tip turns to depress and protect the dura.

One or two holes are made, the fraise introduced, the motor started and the slot cut in the desired direction. A slight up and down motion favors the cutting. Thick, hard bone or adherent dura renders the process slow and tedious, with danger of injuring the dura. The slot is too wide to make an accurately fitting bone flap.

Straight hand saws of various kinds may be used, preferably after holes have been made along the margins of the flap and the skull thickness measured, for example, the Doyen saw with an adjustable guard originally designed for cutting the lamina.

A *circular saw* operated by power is probably the quickest and best instrument for cutting the bone flap. The slot is narrow and the fit perfect. Thickness or density of the bone does not interfere with or delay the cutting. The operator's hands are not fatigued with the preliminary work of opening the skull. There are several varieties of circular saws devised by Horsley, Van Arsdale, Powell, Marsland, Sudeck, Doyen.

The *Powell saw* is very efficient, safe and convenient. By means of a bevel gear the saw operates parallel to the shaft and handle, giving the operator a good view of the cutting edge. The depth of the cut is regulated by an adjustable shoe which comes in contact with the outer surface of the skull, a preliminary hole having been made to measure the skull thickness. All guards or protectors which are designed to travel between the dura and the inner surface of the skull are theoretically ideal and perfectly protect the intracranial structures, but they are difficult of introduction, jam in the saw cut, catch in uneven bone and adherent dura and are really very objectionable.

The dangers and difficulties attendant upon the use of these intra-

cranial guards are familiar to all operators, and it is due to the feeling that they are indispensable to the use of the circular saw that many have refrained from using the saw at all

We have proven absolutely by repeated use that the principle of cutting from *without inward* is perfectly safe, without the use of these intracranial guards, provided the precautions to be mentioned later are followed

Probably the best, safest and quickest of the circular saws and protectors is the type designed by Doyen, which we have modified by omitting the intracranial guard for the reasons above mentioned

This *Doyen type* (Fig 1) is an ordinary circular saw $1\frac{3}{8}$ inches in diameter, fitted with nine strong metal washers $\frac{1}{8}$ inch thick Each

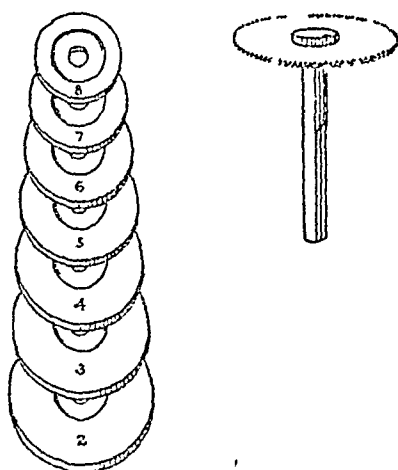


FIG 1 —Doyen circular saw and washers or circular guards The figure on each washer means the depth in millimetres that the saw will cut when that particular washer is fastened on the mandril, next to the saw

washer is stamped with a number indicating the depth in millimetres the saw will cut when that particular washer is fastened on the saw mandril These washers are strong and when attached really become part of the saw, absolutely and accurately limiting the depth of cut no matter how hard or how long the operator presses on the saw It therefore only remains that the skull thickness be known and the proper washer selected so that there will be left uncut a thin portion of bone varying from 1 to 2 mm in thickness Slanting the saw to the skull surface from 10° to 30° will vary the depth of cut from 1 to 2 mm This bevelling process will enable one to cut thinner portions of bone without stopping to change the washer

Power to operate the drills and saw is obtained from an electric motor or a compressed air motor A flexible cable transmits the power from the motor to the cutting tool This flexible cable is sterilized by

wrapping with a sterile bandage, but a better method is to boil it or to put it in the steam sterilizer.

The flexible cable, whether made of links or twisted wire, is awkward to move around and being of a fixed length limits the freedom of the operator. Frequently the stand with the fairly heavy motor has to be moved during an operation. The cable chatters, twists on itself and often breaks from too abrupt bending. The dental machine with its belt and pulleys has many drawbacks and its sterilization is difficult. To overcome these objections to the cable the author began experimenting in 1903 with small electric motors, light enough to be held by the operator himself, with the cutting tools connected directly to the end of the motor shaft (Fig 2)

A metal casing was designed which could be removed in two sections with the wire and sterilized by boiling or by steam and then replaced on the motor just before using. After trying motors of various sizes, weights and speeds, it was finally found that one weighing about 7 to 9 pounds, with a speed of 2600 to 4000 revolutions per minute, which developed about $\frac{1}{10}$ to $\frac{1}{8}$ horse power was most satisfactory.

This always furnished an excess of power which was to be desired, and the extra weight gave increased steadiness. A higher speed than 4000 to 5000 revolutions per minute caused the motor and tools to heat unduly and impaired the delicacy of the drilling and sawing.

These motors are wound to run on a direct current of 110 volts. The same motor with a different winding may be used on a direct current of 220 volts, or on a storage battery of 6 or 12 volts.

It has been hard to find a motor for the alternating current which is light enough for the operator to hold and which will develop sufficient power with a moderate speed. Most of the light ones have a speed of 10,000 to 12,000 revolutions per minute, which is highly objectionable. By experimenting we have found that by making one brush on the motor fixed and the other movable, so that their relation to each other may be varied, the motor wound for the 110-volt direct current will work satisfactorily on the alternating current, but the power is diminished and the speed increased.

About ten feet of flexible wire is attached to the casing and is sterilized with it. This wire can be used even while it is wet and has given no trouble. The current should be turned off at the wall socket or by using a foot switch, except during the actual working time of the motor.

This method of obtaining and applying the power from a small motor held in the hand and provided with a removable metal casing

which is sterilized with the wire attached, has many advantages over any other method which has been tried by the author and is original with him. The operator, holding the sterilized motor in his hands, has perfect freedom of motion and by changing hands can saw or drill in any direction. The sterilization is perfect, even of the wire.

The finger switch on the casing and the foot switch on the floor afford the operator a sure and quick control of the current.

The weight of the motor affords steadiness and does not impair the delicacy of touch. The excess of power shortens the time of operation. For boring the hole the late Dr. Frank Hartley and the author designed the cutter shown in Fig. 3. It starts the hole and cuts through to the dura. It cannot slip all the way in because of its flaring cone-shaped sides. The arrangement of the cutting blades is such that a characteristic sound is heard and a different sensation experienced by the hand of the surgeon just as the tip of the cutter is coming through the inner surface of the skull. If the cutter is withdrawn at this moment and the hole inspected, a thin egg shell like fragment of bone will be seen at the bottom, affording ample protection for the dura. Holes in the skull can be made so quickly and safely with this cutter that one does not hesitate to use it as often as necessary over any region or sinus. It seems to be equally safe and efficient whether the bone is thick or thin.

A little sterile solution trickled on the cutting blades facilitates their action. If the blades become clogged with clotted blood and impacted bone, they may be quickly cleaned by scraping with the prongs of a sharp retractor.

METHOD OF ASSEMBLING THE MOTOR AND CASING (Fig. 4)—After the casing, knob, handle and wire have been boiled or steam sterilized, the casing is wiped dry with sterilized gauze, particularly that portion around the wires and binding posts.

The assistant or nurse who is to put the motor together, having cleaned up preparatory to the operation, holds the motor (Fig. 4, *M*) on a sterile towel in the left hand with the brush end on the towel, with the right hand the portion of the shell (Fig. 4, *B*) containing the spindle (*E*) is screwed down as far as possible or until a mark on its edge is opposite a mark on the motor. The right hand retains hold of the spindle end of this casing, turning the motor so that the brush end is upward. The towel held in the left hand is now thrown aside, the other half of the casing (Fig. 4, *A*) slipped into place and held there by screwing on the knob (Fig. 4, *C*).

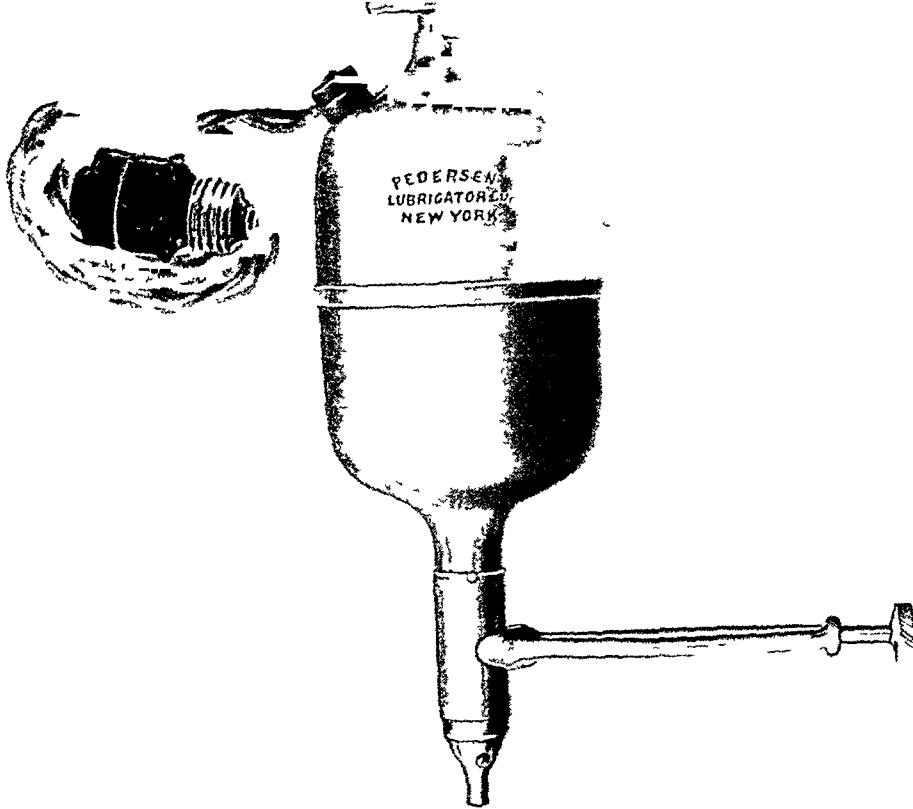


FIG 2 —Motor with casing handle and wire Weight 5 to 9 pounds Speed 2400 to 8000 revolutions per minute About $\frac{1}{10}$ to $\frac{1}{8}$ horse power Made with different windings for 110 volts, 220 volts direct current, also 6 and 12 volts storage battery The 110 volt motors also operate on the alternating current

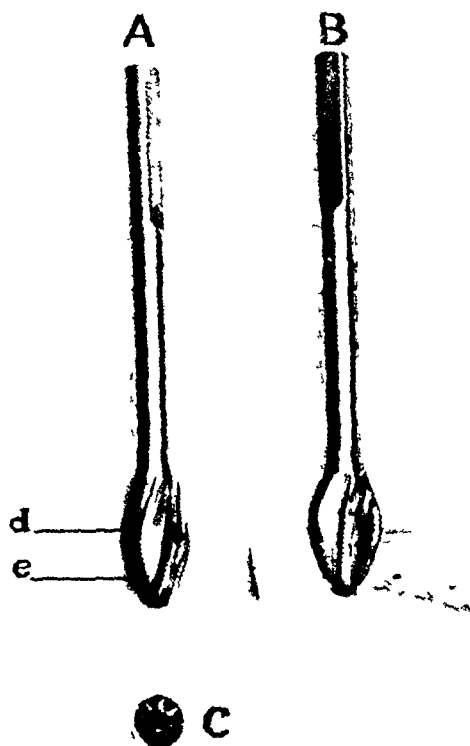


FIG 3 —A single cutter combining the functions of two of the Doyen cutters It may be termed a burr drill and was designed by the late Dr Frank Hartley and myself in 1905 With it holes may be started and finished without danger of injuring the dura or an underlying sinus It emits a peculiar characteristic sound just as the inner table is being penetrated The instrument is withdrawn at this moment the hole is inspected and found to be just through

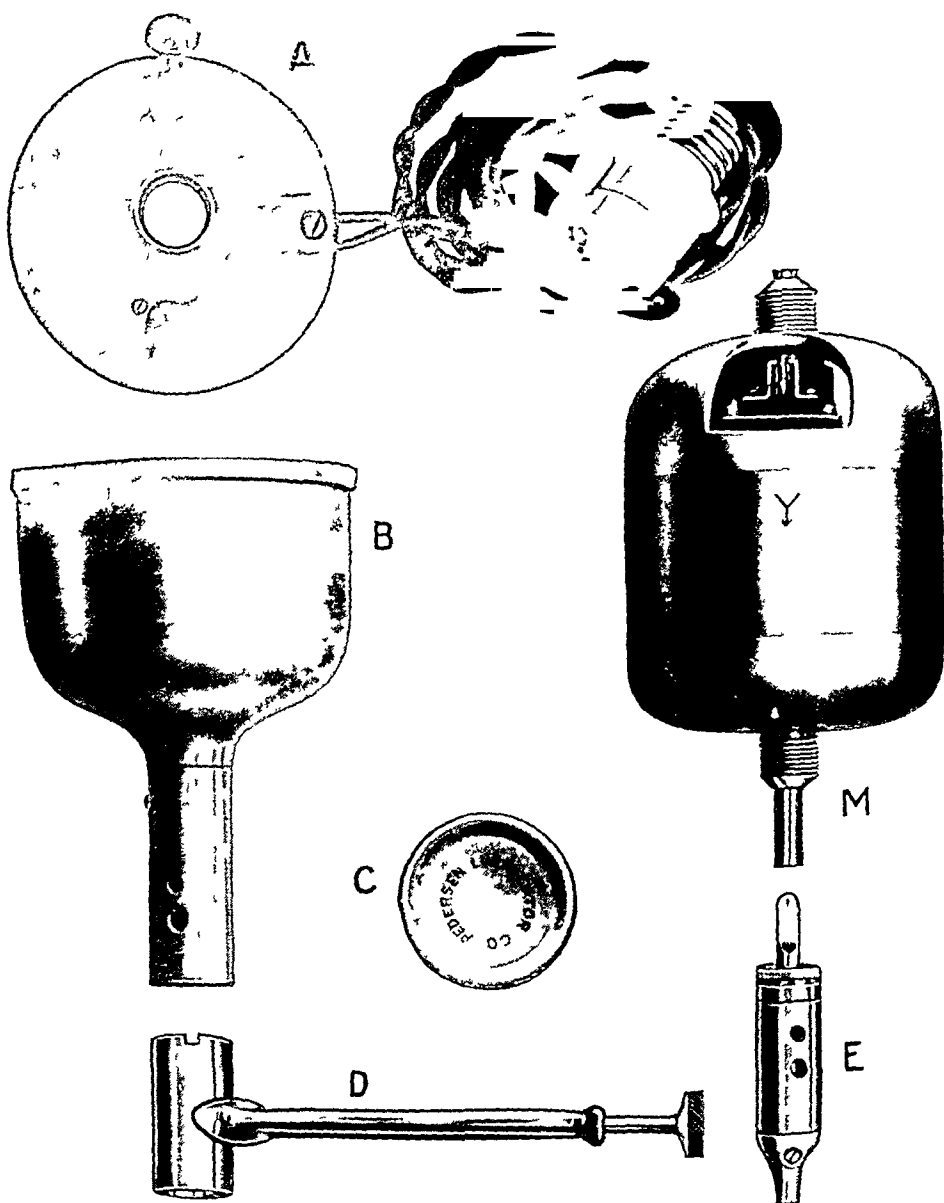


FIG 4—Motor and casing taken apart for sterilizing. Everything including the wire except the motor M can be boiled or steam sterilized. The spindle E may be fastened in B before sterilizing. For assembling the motor and casing see text.

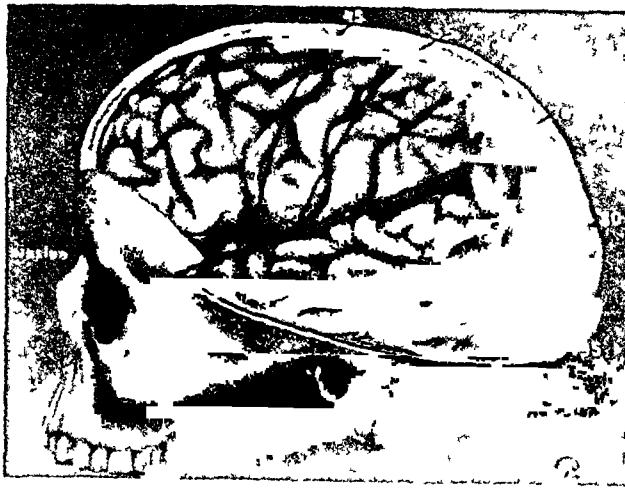


FIG 6 —Chipault craniocerebral topography

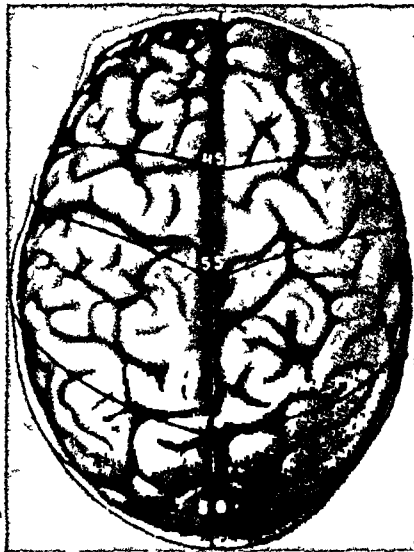


FIG 7 —Chipault craniocerebral topography as viewed from the vertex

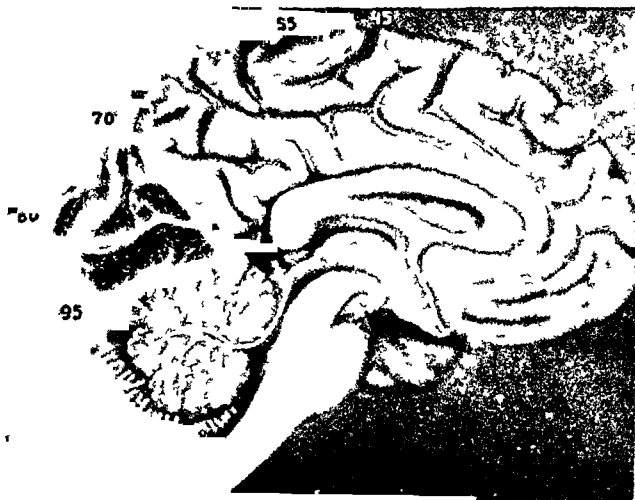


FIG 8 —Chipault craniocerebral topography as viewed from the mesial aspect of the hemisphere

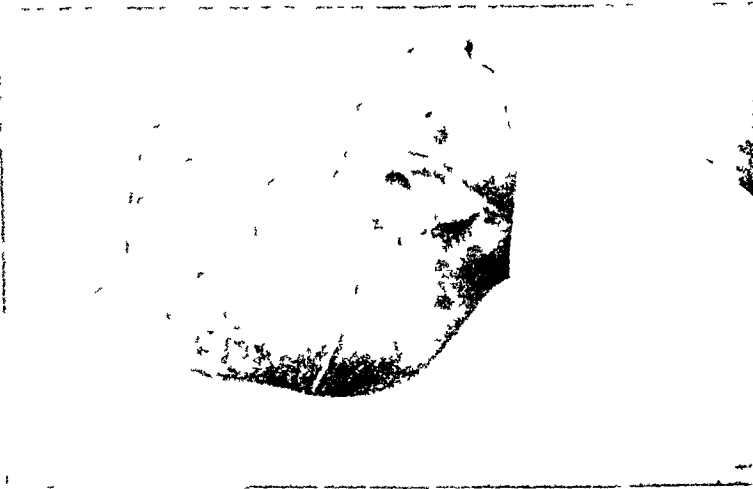


FIG 9 —Head prepared for operation Chipault lines for localization

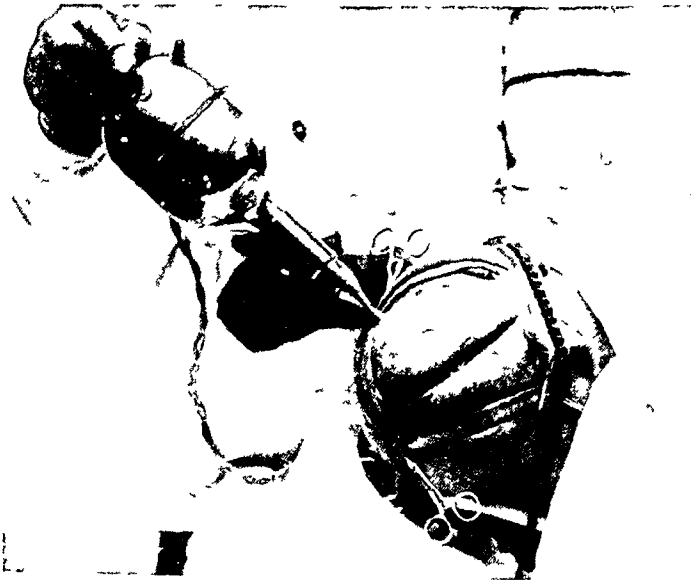


FIG 10 —Boring the holes

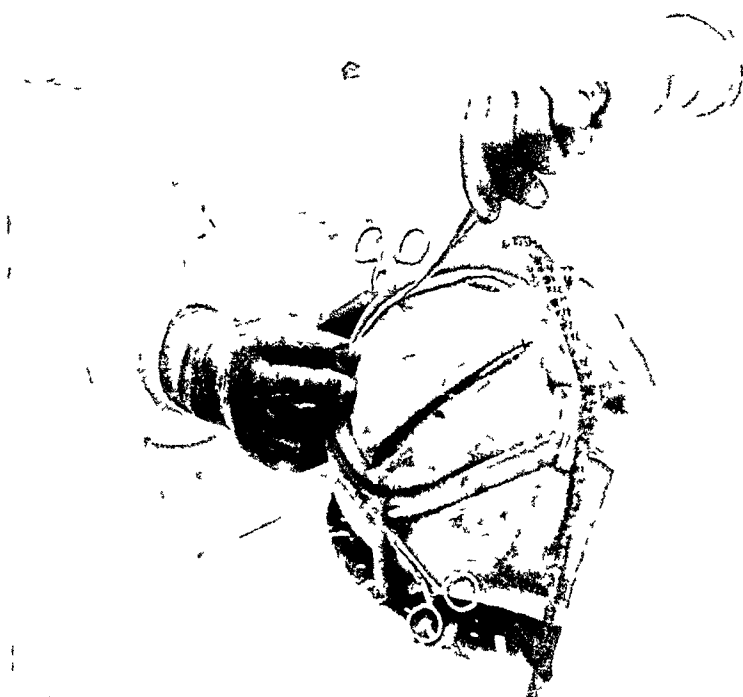


FIG 11 —Measuring the holes

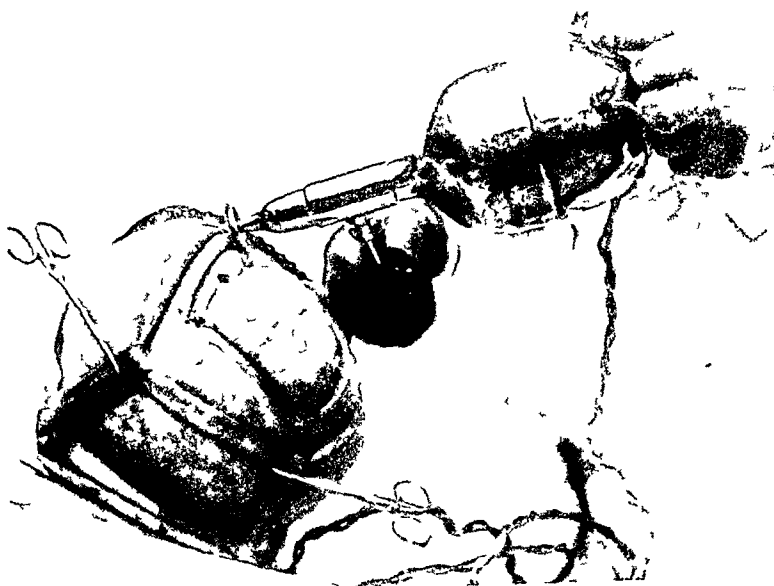


FIG 12 —Cutting the side of the bone flap with circular saw

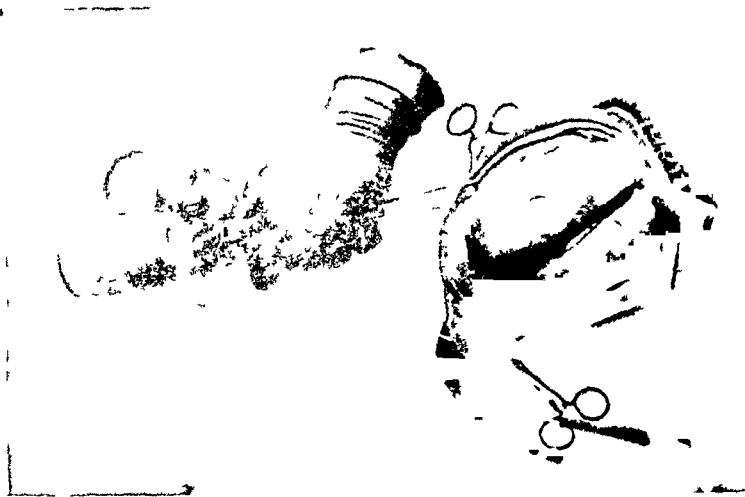


FIG 13 —Cracking the uncut bone at bottom of saw cut



FIG 14 —Prying up the flap fracturing the bone at its base

The handle (Fig. 4, *D*) is now attached and the motor is ready for use.

METHOD OF HOLDING THE MOTOR.—The knob is held against the palm of the left hand, the thumb and index finger manipulate the switch, and the handle is held in the right hand. It will often be more convenient to reverse this position. When the holes are being made in the skull the motor is started before the cutter is placed on the bone. As soon as it starts cutting firm pressure should be made so that it cuts fairly fast and does not merely spin around and heat up. Always cut at right angles to the surface. The cutter may be lifted out of the hole from time to time to observe the depth of cut, but after a little *experience the change in sound will be a perfectly safe indication* that the drill has just about reached the inner surface of the skull. Whatever thin portion remains may be cracked with the measure.

To obtain the skull thickness the Doyen measure (Fig. 5) seems to be the quickest and best to use. This is gently inserted in the hole. The short projecting tip engages the inner surface of the skull, gentle upward



FIG. 5 —Doyen measure

traction is made and the thickness noted on the graduated portion. It is often advisable to measure both sides of the hole.

It is well to have a sterile slate and pencil or some one available to draw the outline of the intended bone flap and mark down in the proper places the measured thickness in millimetres. If adjoining holes show a greater variation than 2 mm more holes should be made. Additional holes should be made on either side of and directly over an important vascular structure, as a sinus. By so doing bone flaps may be made over sinuses without danger of injuring them.

By referring to the diagram with the measured holes the circular saw is fitted with the particular washer or guard which will limit its cutting depth so that there will remain uncut 1 to 2 mm of bone.

This particular saw and washer may be used wherever the bone thickness gives this margin of safety. The thick portions should be cut first. This same saw and washer may be used over thinner portions by holding it at an angle to the surface or by cutting at a bevel.

However, it is generally safer to change the washer to another which will ensure the proper margin of safety of 1 to 2 mm of uncut bone.

By this means all the bone between the various holes is cut, either at

right angles or at a bevel, but nowhere is the cut all the way through
There still remains in every portion 1 to 2 mm of uncut bone

By employing this method the dura and brain cannot be cut

CRACKING THE FLAP—*A thin osteotome which will enter the saw cut* is inserted in the cut at one of the holes and is tapped with the mallet. The osteotome should be held at nearly a tangent to the skull surface and not at right angles to it. This procedure should be repeated at each side of each hole, particular attention being paid to portions known to be thick. When the thin uncut portion has been cracked in this manner the bone flap is pried up with two or four appropriate instruments, chisels, osteotomes, or periosteal elevators. The operator and the assistant each employ two pries, lifting with one and holding with the other. When the flap begins to lift firm pressure over its base should be made with the thumb and then a quick upward motion given to the edge opposite in order to secure an even break. Upward and outward traction is made on the flap as it is turned down, so that its fractured edge will not damage the dura and brain.

PREPARATION OF THE PATIENT—*General*—The patient should be under observation long enough to complete thoroughly all the necessary localization tests, such as an examination of the fundus, and of the ears, blood-pressure, etc. It is most valuable to have the specialists in the various departments work together with the neurologist and the surgeon. If possible enough time should be allowed before the operation to put the patient in the best possible shape by proper medication, by diet, or by filling the tissues with fluids if this be indicated.

Local—The local preparation is much the same as for any operation. The entire head should be shaved unless there is some special reason for not doing so, when one-half may be sufficient.

The lines for the craniocerebral localization should be marked on the scalp with carbolic acid fuchsin. All this may be done on the day preceding the operation.

Cranocerebral Topography—Although there is a great tendency to make a quick, rough estimate with a few marks on the scalp and then proceed with the operation, making an exposure large enough to allow for any slight error in localization, it is more scientific and will be found to be of great value to have the topographical lines plainly marked on the scalp.

This will be of great aid in planning the bone flap and in confirming the exact position of fissures and convolutions after the brain is exposed. The flap with the markings may be turned back in place and the projections of the lines on the cortex noted.

CEREBRAL SURGERY

Of all the various methods, that devised by Chipault has proven to be very satisfactory, as it is based upon a percentage of a measured distance on the scalp and, therefore, is equally accurate for all ages and races. Electrodes with a weak faradic current applied to the exposed cortex will confirm the exact location of many centres.

Chipault Method (Figs 6, 7 and 8) —The distance from the nasion to theinion along the median line is measured in centimetres. This median line is marked on the scalp and on it are indicated points, 45 per cent, 55 per cent, 70 per cent, 80 per cent, 95 per cent, of the measured distance from nasion to inion, always beginning at the nasion.

The retro-orbital tubercle on the frontal process of the malar bone is located and a line drawn from it to the 70 per cent point. This line lies over the Sylvian fissure, is measured and divided into tenths.

The junction of the second and third tenth on this line is joined to the 45 per cent point, and is the precentral line.

The junction of the third and fourth tenth is joined to the 55 per cent point and is the rolandic line.

The retro-orbital tubercle is now joined by a line to the 80 per cent point which constitutes the temporosphenoidal line.

Another line is drawn from the retro-orbital tubercle to the 95 per cent point which, in its posterior two-thirds, overlies the lateral sinus.

POSITION OF THE PATIENT ON THE TABLE—The patient should be placed upon the operating table and arranged in the position desired, as far as possible, before the anæsthetic is started. For operations on the lateral and posterolateral regions the shoulder of that side should be raised on a sand bag in order to avoid too extreme rotation of the neck. To hold the head from rolling from side to side it should rest in a furrow between two small short sand bags placed close to each other and parallel to the long axis of the body. For operations upon the posterior region, the cerebellum and occipital lobes, the patient should be placed on his abdomen face downward, the forehead supported on a special rest attached to the end of the table, or the forehead may rest on a pad on another table or stand about six or eight inches from the end of the operating table.

A long narrow sand bag is placed under each shoulder parallel to the vertebral column in order to lift the thorax from the table and to afford free respiration. Provision should be made to secure extreme flexion of the neck when desired. This is accomplished by lowering the forehead support or by raising the shoulders by putting larger sand bags under them. The entire body of the patient or the upper portion should be elevated 20° to 45° . A heavy strap should be used to hold the

thighs to the table to prevent the patient from slipping. This elevation of the head lessens the cerebral congestion and oozing and is changed as occasion requires.

ANÆSTHESIA—Certain cases with marked stupor and many of the second stage operations can be operated upon with local anæsthesia, the fluid, 1 per cent novocaine, being injected in and along the line of cut and also into the sensory nerve trunks supplying that region. With this method, however, a small amount of ether may be required from time to time.

The majority of cases will require a general anæsthesia for which ether by the nasopharyngeal or intratracheal method is the best. Special care should be taken to maintain a light, even anæsthesia with no cyanosis. The nasopharyngeal method has both simplicity and efficiency to recommend it. The bottle containing the ether should be placed below the patient's head, preferably hung on the lower bar of the table. The tube in the nostril, one is sufficient, should be as large as can be easily inserted without trauma. It should extend to a point just beyond the uvula, a distance about equal to that from the nostril to the lobe of the ear. Another method which will ensure the proper depth of the tube in the nostril is to insert the tube carefully into the nostril while it is connected to the bottle containing the ether.

When the patient's respiratory movements cause the ether in the bottle to bubble the insertion is sufficient and the tube should be fastened at that depth. This may be easily done by wrapping a piece of adhesive plaster, about $\frac{1}{4}$ inch wide and 8 or 10 inches long, around the tube very close to the nostril and applying it to the cheek on either side. A second plaster similar to this one adds security.

The ordinary cautery bulb or foot bellows may be used to force the ether vapor into the pharynx. A very excellent method is to connect the oxygen tank to the ether bottle and thus deliver a steady, easily regulated mixture to the patient's pharynx, of air, ether and oxygen.

The tube between nose and bottle should have a connecting link which can be taken apart from time to time to prevent the patient's receiving an excess of ether vapor, for by this snugly-fitting nasal tube considerable vapor is drawn in with each inspiration. In other words, the patient anæsthetizes himself and it is only necessary to regulate the amount. The anæsthesia is started in the usual manner and as soon as possible the change is made to the nasal tube.

For a short time, or until the patient is sufficiently under, both the face mask with the drop ether method as well as the nasal anæsthesia may have to be used. When everything is working evenly the patient is

put in the proper position, the operative field prepared and the sterile towels and sheets applied.

PREPARATION OF THE OPERATIVE FIELD may be accomplished in various ways. It has been difficult to find any substance for marking the topographical lines on the scalp which is not more or less obliterated by the subsequent sterilization of the skin. Carbolic acid fuchsin is as satisfactory as any. In order to preserve the markings they may be gone over with tincture of iodine on a narrow cotton applicator and then the centre of this sterilized line, which is about $\frac{1}{4}$ inch wide, is scratched with the point of a scalpel or needle.

The portion of the localizing system applicable to that particular case is thus scratched on the scalp (Fig 9). After this the remainder of the scalp is prepared. Half or full strength iodine, with or without a previous wiping with benzene or with alcohol or ether, may be used. A generous portion of the head should be prepared so that as many landmarks and as much of the topographical markings as possible may be left uncovered by the sterile towels and sheet.

The towels and sheet should be smoothly applied and securely clamped to the scalp in several places so that there will not be any slipping. For this purpose sharp-toothed towel clamps are made to penetrate the towel and also the scalp. If these clamps are not available a strong suture on a curved needle will answer the purpose. Failure to protect thus securely the operative field greatly increases the danger of infection.

FORM OF FLAP.—The osteoplastic flap should be planned of a sufficient size to extend somewhat beyond the supposed limits of the lesion. The base should be in the region where the bone is thinnest and will break easily, also where the best possible blood supply may be secured. For example, flaps for exposing the lateral portion of the skull, be it frontolateral, midlateral or posterolateral, have their base low down in the temporal fossa.

A description with illustrations of the flaps appropriate for the various regions of the skull was given in the article to which reference has been made. Intracranial lesions located near the midline, whether frontal on the vertex or occipital, are well exposed by making a double flap. Another element to be considered in fashioning osteoplastic flaps is the cosmetic result and the desire to keep the scar as much as possible within the hair line. For example, the Elsberg flap for exposing the pituitary region.

HEMORRHAGE.—The next step is the control of hemorrhage from the scalp, and of all the methods devised, circular, pneumatic, and

regional tourniquets, Kredel plates, clips, clamps and suture of the cut edge, a single row of the modified Heidenham stitch is the best

This modified Heidenham suture of strong catgut is introduced with a full curved needle each time down to the bone, taking in about $\frac{1}{2}$ to $\frac{3}{4}$ inch and each time overlapping about half of the previous stitch. This makes a continuous row of overlapped sutures which tightly compress all the tissue between the skin surface and the bone. These are placed about $\frac{1}{2}$ inch outside of the proposed cut in the scalp, extend across the base of the flap, and completely surround it.

The scalp incision for one side of the flap is now made and should extend with one stroke of the knife down to the bone. Occasionally a few bleeding vessels will appear in the cut edge. These may be clamped and tied with a transfixion suture. When the bleeding from this incision is controlled, the second side of the flap may be cut and then the third. Oftentimes a horseshoe-shaped flap is made instead of three sides of a trapezoid. In any case it is well to make the incision in the scalp for only a short distance at a time in order to secure more thorough hæmostasis. The pressure of the assistant's fingers or flat of the hand along each side of the cut will control the bleeding until the clamp and suture can be applied.

With a sharp periosteal elevator the periosteum is slightly separated from the bone for about one-half inch along the line of incision, but the separation is generally outward, as the attachment of all the soft parts to the bone flap is preserved as carefully as possible in order to secure the best nutrition.

With the cutter shown in Fig 3 mounted in the end of the electric motor, holes are bored at the corners of the flap and also along the sides, the number being such that between any adjoining two the skull appears to be of fairly uniform thickness (Fig 10). If this varies more than 2 mm another hole is bored.

If there is much hemorrhage from the holes bone wax or a piece of muscle or fascia may be pressed in to control it.

An outline of the cut is now drawn and the position of the holes indicated.

At each hole the skull thickness is measured in millimetres from within out by the Doyen measure, and the amount noted on the diagram (Fig 11).

It is well to cut the thicker portions of the bone first.

The circular saw is fitted with a washer which will cut these thickest portions but will leave uncut the 1 to 2 mm of bone. The next thinner

CEREBRAL SURGERY

portions may be cut with the same saw and washer by cutting at a bevel which will diminish the depth of the cut by 1 to 2 mm (Fig 12)

For the next thinner portions it will be necessary to use another washer. Bleeding from the saw cut may be controlled by bone wax. If it cannot be thus controlled the cutting of the remaining sides is hastened, the bone cracked and the flap turned down as quickly as possible in order to make the bleeding points accessible.

The uncut bone of the inner table is now cracked with the osteotome and the flap pried up (Fig 13), fractured at the base and turned down (Fig 14).

Hemorrhage from its edge or inner surface is controlled with bone wax or muscle. The osteoplastic flap is wrapped in a warm towel or gauze pad wet with salt solution, and gently retracted, care being taken to prevent the stripping of the bone from the soft parts.

DURA—The dural flap is generally made the same in shape as the bone flap, but about $\frac{1}{4}$ inch smaller on each side so that it may be returned and sutured if possible. A modification of this rule arises when the subsequent suture line would lie over important cortical centres or when, from increased intracranial pressure, the dura could not be sutured.

In these cases it is better to plan the dural flap so that its base or uncut side will protect the important centres under it.

HEMORRHAGE FROM DURA—Vessels in the dura are best controlled by passing under them a fine curved needle with very fine catgut or silk. To lessen the danger of cortical injury by this procedure the incision in the dura may be made close to the vessel and then the curved needle passed from within outward. Two ligatures are passed and the dura and its vessels cut between them.

HEMORRHAGE FROM CORTEX AND BRAIN—Hemorrhage from the cortex is controlled by snipping off a small bit of muscle or fascia from the edge of the scalp incision and gently laying it over the bleeding point and carefully holding it there for a few minutes when it will be found to adhere, retaining its position and checking the bleeding. Or moist cotton or gauze soaked in adrenalin may be laid over the bleeding point. Attempts at clamping or tying generally increase the hemorrhage.

Of course, vessels of considerable size may have to be surrounded with a fine curved needle and fine catgut or silk and tied.

The silver wire clips applied with a specially constructed forceps are, at times, serviceable, but often the force or manipulation required to apply the clips tears up more tissue and increases the bleeding.

TREATMENT OF THE LESION FOUND—If a tumor is found presenting

on the cortex and it seems to be fairly well limited in its extent, the surrounding brain substance is gently pushed away from it with some suitable instrument, an ordinary spoon of appropriate size answers this purpose very well

By this means the tumor-mass is gradually freed from its bed and lifted out. If the growth is below the cortical surface a clean incision at right angles to the surface and over the convexity of a convolution may be made with a scalpel, suitable retractors inserted and the tumor exposed

If the growth is diffuse its attempted removal is followed by such unfortunate results, both immediate and remote, hemorrhage, shock, paralysis and recurrence, that it is doubtful whether anything more than a decompression should be done. Many factors enter into the decision as to whether or not to remove these rather diffuse growths

If the diffuse tumor mass is in a silent portion of the brain, away from important centres so that the incision may be some distance from its boundaries, its removal may be attempted

When situated over important motor centres and considerable paralysis already exists, the removal of the tumor may be undertaken if the dangers of a subsequent increased paralysis have been previously explained to the patient and his relatives

If removal of the diffuse growth is decided upon, the brain at some distance from it may be carefully tied off with deep catgut sutures, or merely the vessels entering the region are ligated, and an incision with a scalpel made around it. This is deepened with some blunt instrument, as a spoon, and the growth with some surrounding brain tissue scooped out. Hemorrhage from the resulting cavity may be controlled by gentle pressure for a few minutes with moist cotton or vaseline. Or a piece of fat, muscle, or fascia, previously taken from some other part of the body, may be placed in the cavity. These latter substances may be left in place and the dural flap sutured over them

Brain cysts should be removed with the entire cyst wall, if this can be done, in order to prevent their refilling. When this is not possible they should be opened and drained

Cerebral abscess is generally secondary to infection in the frontal sinus, middle ear, mastoid, or wound of soft parts or bone

If possible the abscess should be opened and drained through the same tract or stalk by which it entered. If search is to be made for an abscess deep in the brain a rather large, blunt-pointed needle should be used, or a grooved director, or a long, narrow-bladed knife may be inserted at right angles to the brain surface. The content of the

abscess is usually too thick to escape through the ordinary aspirating needle. As soon as the pus is located a dressing forceps should be passed along the side of the exploring instrument to enlarge the opening. Then a double suction tube should be introduced and the cavity aspirated as completely as possible. Before the instrument is removed one or two good-sized drainage tubes should be inserted.

It is often difficult to locate these collections of pus in the brain and even more so to procure and maintain efficient drainage. Imperfect drainage probably accounts for many of the long-standing cases of cerebral infection and also for many of the fatal results. One rule should be followed. as soon as the cerebral abscess is located it should never be left without some guiding instrument to its interior, the first should never be removed until another director, probe, or tube has been passed alongside it.

As a retractor on the tumor mass or cyst wall the suction cup as devised by Fedor Krause is very useful. Where the continuous suction is obtainable the cup may be connected to that.

As an adjunct to sponging or a substitute for it, one of the appropriate tips connected with the continuous suction affords a clear field by removing blood and cerebrospinal fluid, lessens trauma to the brain and shortens the time of operation.

DECOMPRESSION —Decompression as advocated by Harvey Cushing is a valuable procedure in many cases. It is to be desired that the area of bone removed be so situated that the uncut muscle can be brought over it to aid in making a firm and elastic covering. The brain thus protrudes gradually and the danger of hemorrhage into the cortex and laceration of the brain tissue is lessened.

Another factor governing the location of the decompression area is the necessity of avoiding important centres. Therefore the subtemporal region on the right side, to avoid speech centres, is the place generally selected. If the protrusion is not expected to be very marked the left subtemporal region is a safe area to choose.

A decompression is generally done by making a trephine or burr opening and then cutting out the surrounding bone with the rongeurs. If the skull is not thick and dense this method is satisfactory.

The circular saw cannot very well be used for this purpose but the burr drill run by the motor will quickly and safely surround the desired area with holes which may be readily connected with any of the slot-cutting forceps. Or the entire area to be removed may be filled with holes close to each other and the rongeurs used to complete the removal. This combined use of the motor-driven burr drill followed by the slot-

cutting forceps or the rongeurs is very efficient and a great saver of time and energy

Indications for decompression as a palliative measure are the relief of increased intracranial pressure, thereby lessening the danger that important centres and functions may be entirely destroyed, the greatly increased comfort of the patient and the prolongation of his life. Decompression is also employed as a preliminary to a radical operation for the removal of the intracranial lesion. It is often done on the side opposite the lesion so that when the radical operation is undertaken there will be less trauma to the brain from its rapid protrusion.

In many cases, even with greatly increased intracranial pressure, it is better to plan the first operation as an exploratory one, making a large osteoplastic flap over the site of the tumor. This opening may be sufficient for the radical removal of the growth or admirably serve as a decompression.

The protrusion of the brain through a large opening is less damaging to it than when it is crowded through a small one. With the technic already described a large opening may be made with the electric saw and motor as quickly and with as little shock to the patient as a smaller opening made by other methods.

After the bone flap is turned down and the dural flap reflected a careful estimate is made of the extent of the growth, the problem of its removal and the patient's condition. In certain cases, when the condition of the patient will warrant it, the tumor may be removed at this time. However, for the majority of cases, probably the two-stage operation is to be preferred. If there is much pressure this exploratory operation is converted into a decompression. The dura is left unsutured, and the bone is separated from the soft parts beginning at the fractured edge or base. It is then firmly held with the bone forceps and as much of the bone as desired removed with the circular saw. This portion is generally overlapped by the muscle in the flap and makes an ideal decompression. The entire bone may be removed if desired and only the soft parts sutured in place. After a week or ten days the removal of the growth may be attempted if this is thought best. By this method the advantages of a decompression are obtained and in addition an accurate knowledge of the intracranial lesion. If the intracranial pressure is not sufficiently lowered by this procedure, a subtemporal decompression on the opposite side may be performed at some period before the attempted removal of the tumor.

EXPOSURE OF THE OCCIPITAL LOBES AND THE CEREBELLUM —The posterior portion of the head deserves special attention. For exposure

of the occipital lobes of the cerebrum the double flap described in the former article is very satisfactory, but the osteoplastic flap principle for exposing the cerebellum and the cerebello-pontine angle has not been used to any great extent. The majority of the lesions in these regions have been exposed by stripping the soft parts from the bone and then removing the bone entirely by means of the trephine and rongeurs. When there is great pressure this bone removal will be necessary anyway and if the bone is thin and not very vascular this method answers the purpose. If the bone is dense and thick this is a long and fatiguing procedure to the patient and to the operator and there may be considerable hemorrhage.

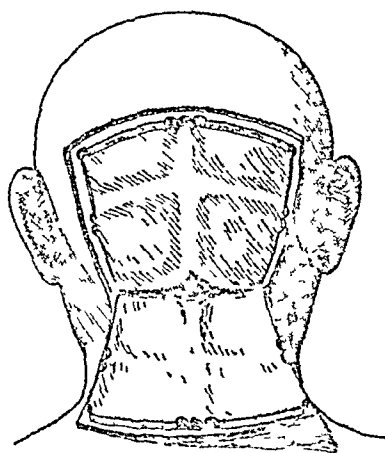


FIG 15 —Osteoplastic flap for exposing both occipital lobes of the cerebrum and also both lobes of the cerebellum. Many more holes than are shown in the picture should be employed, particularly over the sinuses and transversely across the base of the bone flap. This transverse row of holes fixes the point of breakage so that the margin of the foramen magnum is not injured. The median incision from the external occipital protuberance downward does not show.

Fig 15 shows an osteoplastic flap for exposing both occipital lobes of the cerebrum and both lobes of the cerebellum. The lateral boundaries extend downward and slightly inward close to the posterior border of the mastoid, just far enough removed from it to avoid opening the mastoid cells. The upper border is about $1\frac{1}{2}$ to 2 inches above the lateral sinus and the fractured edge is just above the foramen magnum.

To ensure the proper breaking of the flap the bone forming its base is narrowed and weakened by the following procedure. An incision 2 to 3 inches long is made from the external occipital protuberance downward on the neck. This is deepened to the bone. At the desired site of fracture, just above the foramen magnum, the soft parts are separated from the bone with the periosteal elevator, and retracted laterally as much as possible. The burr drill operated by the motor is used to make three or four holes close to each other and extending outward, in order to divide the thickened occipital crest.

At the lower end of each lateral incision the soft parts are separated and retracted inward and the bone weakened in a similar manner. The only uncut portion of bone in the base of the flap is now very narrow and thin and will easily break without endangering the margin of the foramen magnum. The cutting of this flap is the same as that already described for any other region, except that more drill holes are used. Drilling these holes close together is a perfectly safe way of dividing the bone over the lateral sinus. The great variation in thickness along the mastoid and the bone below it will necessitate the drilling of several extra holes close together. By using plenty of holes, which are safely and quickly made, the thickness of the uncut bone between them is

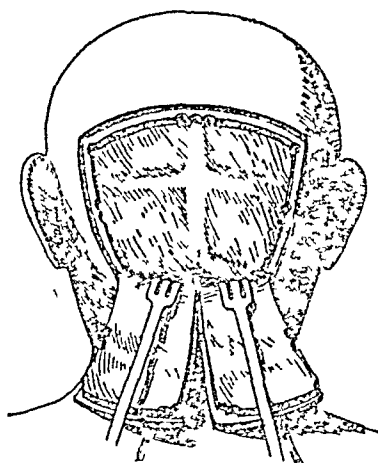


FIG 16 —In order to afford better retraction and better exposure the large flap shown in Fig 15 is split down the middle with the circular saw, cutting from within outward, while the flap is held down as far as possible. After sawing the bone the soft parts are cut with the scalpel. This gives two equal osteoplastic flaps which may be retracted downward and outward.

accurately known and may be cut with the circular saw without danger to the dura or brain.

Patients with a short thick neck where good retraction is difficult may require a median division of this flap. This is easily done after the bone is turned down by using the circular saw, with or without a washer, cutting entirely through the bone in the median line on the internal surface. The soft parts are then divided with a scalpel, the two osteoplastic flaps are retracted downward and outward as shown in Fig 16.

The osteoplastic flap for this cerebellar region has many points to recommend it. 1. The hemorrhage is not any greater than in the other methods, probably even less. A Heidenham stitch controls much of that from the soft parts. The holes and saw cut in the bone bleed only moderately. There is no extensive bleeding because the soft parts are

not stripped from the bone as in the other methods. The cut can be made with the burr or saw over the sinuses with perfect safety. When the bone is cracked and turned down the vessels extending from the bone to the sinuses and the dura are torn across, but this would happen to the same extent with any other method used. 2 The area exposed is greater. 3 Much less time is required to make even a greater exposure. 4 The thickness and density of the bone does not increase the difficulties of the procedure as the drill and saw work equally well in both thick and thin bone. 5 The one operation gives a good exploratory opening and also a decompression if desired. If, after the flap is made, there is much pressure, the margin of the foramen magnum should be cut away with the rongeurs and a portion or all of the bone in the flap removed. 6 Restoration of the protective cranium is possible. If the pressure is normal or only slightly increased the margin of the foramen magnum may or may not be cut away as desired, but the remainder of the bone flap should be returned to place and the soft parts carefully sutured.

The dural flap to expose the cerebellum may be made in a variety of ways, but the important point is the division between double ligatures of the occipital sinus and cerebellar falx. This greatly increases the ability to retract the cerebellar lobes, inspect their lateral and anterior surfaces and also the cerebellar pontine angle. This exposure according to this technic has been done twice without any difficulties or complications. One case, a beginning basilar meningitis, was done by Dr. W. A. Downes and the author, at the New York Hospital. The patient made an uneventful recovery and was afterward shown before the Surgical Society of New York. The other case, a possible meningitis or brain abscess, was done by the author, at the Fordham Hospital. This case died the following day and the autopsy showed a very extensive general meningitis.

FOR EXPOSING THE CEREBELLAR PONTINE ANGLE in cases where there is little if any increased pressure, Dr. A. S. Taylor has devised an osteoplastic flap shown in Figure 17, and employed it for exposing and dividing the sensory filaments of the facial nerve. The exposure extends from the posterior border of the mastoid nearly to the median line. The upper border is about $\frac{1}{2}$ to 1 inch above the lateral sinus. Numerous holes are drilled, measured, and the bone cut with the circular saw. The base is undercut and narrowed from each side to ensure the proper line of breakage. The cerebellum is retracted toward the median line and a long slender tube, bent at an angle, connected with the continuous suction, keeps the depth of the wound free from blood and cerebrospinal fluid. A cystoscopic lamp on a flexible holder is placed in one corner

of the opening and furnishes good illumination of the structures entering the internal auditory meatus

REPAIR OF BONE DEFECTS IN THE SKULL—Small defects and even large ones if not over important areas may be left alone. The tissue over them thickens more or less and affords fair protection. However, it is generally better to provide some strong, rigid protection for the exposed portions of brain. After the usual preparations a flap of soft parts, about one-half inch larger on each side than the defect, is turned down. Burr holes are made at the corners and along the sides, the bone measured and cut with the circular saw on a bevel, and the narrow strip of bone surrounding the entire bone defect removed. This leaves an opening somewhat larger than the one already present but with clean cut bevelled edges

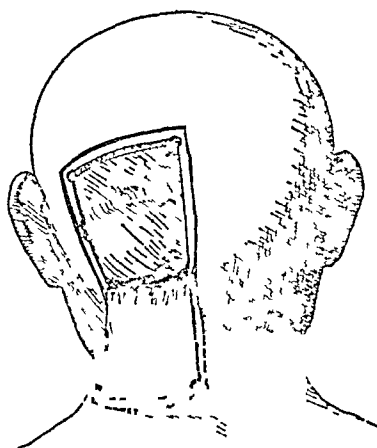


FIG 17—Single osteoplastic flap for exposing the cerebellar pontine angle where there is no increased pressure and a large opening is not required. Many more holes should be employed than are shown in the diagram

A sheet of translucent celluloid, $\frac{1}{10}$ to $\frac{1}{8}$ inches thick, which has been sterilized by boiling and while warm has been bent to a curvature similar to that of the skull, is laid over the opening and with some sharp-pointed instrument the outline of the opening is scratched on it. The celluloid is now placed on the table and with a fine scroll saw the piece is cut out as marked. This piece is now placed over the opening and minor changes in size and curvature noted. The piece is removed, grasped with a long clamp held in the boiling water, and while hot is bent with the fingers or another clamp to the proper curvature. It is very necessary to have the fit so that the edge will be even with the skull surface but rest securely on the bevelled margin of the opening, so that it cannot be forced in on the brain. A small drill hole is made at each corner and at the middle of each side of the bony margin of the opening. Corresponding holes are made in the plate. If the cortex is

uncovered by dura, Cargile membrane or a thin sheet of celloidin should be laid over it and tucked under the bony margin of the opening to prevent adhesions. The celluloid plate is then adjusted and fastened in place with chromic catgut sutures and the scalp thoroughly sutured over it. The ease of moulding and fitting the celluloid makes it better fitted for this purpose than other materials, as aluminum or silver. A bone graft from a rib or from the tibia with the periosteum intact may be used, the opening prepared as mentioned above, the bone graft notched, drilled and securely fastened in place so that it cannot slip.

TREATMENT OF FRACTURED SKULL—A simple depressed fracture should be exposed by a flap consisting of the soft parts including the periosteum, and then with a suitable instrument the depressed portion is elevated. To do this the overlapping edge along the fracture line may have to be removed with the chisel or gouge. Another method is to make a few burr holes near the overlapping edge or at the bottom of the depression. These may be enlarged slightly with the rongeurs and then some instrument introduced under the edge of the bone to lift or pry it into place. Still another way after the soft parts have been reflected is to make burr holes at the periphery of the depressed area, measure the thickness and with the circular saw join these holes, crack, and then lift out the entire depressed area. One then inspects the dura for tear and subdural hemorrhage, opens and turns out the clot and stops the bleeding. The depressed portion removed is laid on a smooth, firm surface and with the fingers or a mallet the depression is corrected. The piece or pieces are now returned to their proper place and the scalp replaced and sutured. In many cases an osteoplastic flap cannot be made because the soft parts are more or less separated from the depressed area as a result of the trauma.

Head injuries with symptoms of internal hemorrhage which can be localized or give only the general signs of increased intracranial pressure, embarrassed heart or respiration, or increasing stupor, should be operated upon and in the absence of localizing signs and when the condition does not warrant waiting, a small incision and a small trephine opening over the temporal fossa or occipital lobe or over the cerebellum, with an inspection of and a small incision in the dura if necessary, can be quickly made and quickly closed with a few sutures if nothing is found. This procedure is done at each of the regions mentioned, first on one side and then on the other if necessary.

If the opening gives evidence of hemorrhage or lacerated brain it may be used as one corner of an osteoplastic flap planned to expose this region. The dural flap is then made and the clot removed. The bleeding

is checked and the portion of bone is removed if there is lacerated brain or increased pressure. Rubber tissue drains are then inserted under the dura, and the dura sutured over them if possible. The wound is then closed in the usual manner.

If one feels sure of some intracranial injury, never fail to explore the opposite side, provided that nothing is found on the side entered first. There are a certain number of cases which will have a severe hemorrhage or lacerated brain on both sides and should be treated accordingly. Compound fractures of the skull should be treated as soon as possible after the injury. The original wound is enlarged in a direction which will expose the fracture. A flap of the soft parts may be made. A border of bone $\frac{1}{2}$ to $\frac{3}{4}$ inches wide surrounding the fracture should be drilled, measured, and cut with the saw and lifted out.

This method can be done with less hemorrhage and laceration of the brain than would result from cutting away the fractured edge with the rongeurs. If the dura and brain are lacerated and soiled they should be irrigated with sterile salt solution and the ragged tags of dura and loose brain tissue removed. Bleeding should be controlled by applying a small piece of muscle or fascia cut from the edge of the scalp incision. If the bone fragments are clean and there is only slight tendency for the brain to bulge, Cargile membrane or thin sheet celloidin may be laid over the brain devoid of dura, the bone replaced and the soft parts sutured in place with rubber tissue drains in the corners.

In other cases with severe cortical laceration and grave danger of infection the bone removed by the above method is not replaced. Liberal drainage down to the lacerated area should be provided for by rubber tissue drains, the soft parts sutured and a wet dressing applied. This dressing should be kept moist, changed frequently, and the drains moved in and out but not entirely removed for several days until danger of infection is over. At some later time the defect may be closed with a celluloid plate or bone graft.

IN CONCLUSION the following points deserve particular emphasis

- 1 The importance of early diagnosis and accurate localization
- 2 Early operation in all cases, both traumatic and pathological, before irreparable damage is done to the brain from hemorrhage, œdema, blood clot, sepsis or prolonged pressure. And in the case of a tumor, before it has increased to such a degree as to render its removal impossible.

- 3 A method of procedure should be selected which combines exploration, radical removal or a decompression, as the lesion seems to indicate. The skull should be opened by a large osteoplastic flap so

that the intracranial condition may be accurately inspected and radically dealt with if that seems advisable. If the condition is inoperable or a second stage operation is decided upon, a portion of this same bone flap may be removed for a decompression and the remainder sutured in place

4 The osteoplastic flap, in the majority of cases, furnishes the most satisfactory method of opening the skull and has many points in its favor. It gives the largest possible exposure without increasing the duration or the dangers of the operation. It enables the surgeon to combine in one operation exploration, radical treatment of the lesion, and also all the benefits of a decompression, if that be indicated. It provides by its accurate fit a restoration of the protecting cranium.

H. H. Tooth, in a recent article based on the analysis of 500 cases of brain tumor, states that, "Severe shock at the first stage is not generally repeated at the second stage and is therefore probably due to bone removal." Accordingly anything which lessens the danger of this first stage should be adopted.

5 The selection of a technic and such instruments as will enable the operator to make an osteoplastic flap easily, quickly, and safely with minimum shock and hemorrhage, regardless of size or position or density of the bone.

6 The principle of cutting the skull from without inward is perfectly safe and quick under all conditions. The cutters best adapted for this are the burr drill and the Doyen circular saw protected with washers.

7. The power to operate these cutters is best obtained by using a small electric motor, light enough to be held by the operator, so constructed that the casing and wire may be removed for sterilizing, either by boiling or in steam.

8 Continuous suction applied through a tube of appropriate size and shape furnishes a good retractor for the soft friable tumor mass. Continuous suction applied through a suitable tip, preferably a small, malleable, metal tube which can be easily bent, is a most valuable adjunct to sponging and aids in furnishing a clear operative field, free from blood and cerebrospinal fluid. This is particularly useful in operations on the Gasserian ganglion and for lesions in the cerebellar pontine angle, where the small size of the tube in the wound does not interfere with the operator, although the wound is narrow and deep.

9 Good illumination is most important when the operative field is narrow and deep. This is best obtained by using a cystoscopic lamp on a long flexible metal holder, all of which, including the wire, should be sterilized.

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LARYNGEAL DIVERTICULA

BY GEORGE E. SHAMBAUGH, M D

AND

DEAN LEWIS, M.D.

OF CHICAGO

DIVERTICULA of the mucous membrane of the larynx which communicate with its interior by means of the appendix of the ventricle are rare. Many of the cases reported in the earlier literature as true diverticula cannot be accepted as such when subjected to critical examination, for the data cited would indicate that the lesion was a thyreoglossal cyst, a vascular struma, or a localized emphysema resulting from perforation of the cartilages of the larynx by some inflammatory process, such as tuberculosis.

Larrey apparently was the first to give an accurate description of this condition. During the Egyptian campaign he saw the first examples of these air tumors which developed in the anterior part of the neck, especially at the side of the larynx, and which he regarded as a variety of goitre. They occurred in the blind who were employed by the priests to shout the verses of the Koran from the minarets. These air tumors developed especially in those who had followed this occupation for a number of years. Finally many were compelled to wear pasteboard collars covered with cotton which enclosed the neck and larynx, in order to prevent distention of the diverticulum and consequent loss of voice. In marked cases the voice was so much interfered with that these people could no longer shout the verses and they were then assigned the duty of tending the fish ponds in the temple.

After returning home from the Egyptian campaign, Larrey observed the same lesion in two of the subordinate officers of the guard. In one of these a tumor the size and shape of an apple was found on each side of the larynx. The tumor was tense and not tender on pressure, the skin covering it unchanged in color, and the surface slightly irregular. Both officers had lost their voices and could speak only in a whisper even when they compressed the swellings. Larrey could cause the swellings to disappear by pressure. Finally the officers had to leave the service because of interference with the voice occasioned by these air tumors.

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ticula, for, according to him, the cases were apparently much more frequent than we know them to be at present. The general character and location of the air tumors and the interference with the voice, as noted in the subordinate officers of the guard, are however quite characteristic and leave but little doubt as to the nature of the lesion in some of the cases observed by him. It is interesting to note that Larrey thought these diverticula similar to the buccal pouches of apes, in which food is stored or hidden, whereas they are the analogue of the extralaryngeal extension of the ventricle found in howling monkeys.

Bennett gave the first anatomical description. Other anatomical descriptions have been given by Gruber, Rudinger and E. Meyer, diverticula having been noted in 8 cadavers. In most of these cases the diverticulum has been bilateral.

The findings in Meyer's case will be cited, as the details regarding the relations of the diverticulum are given. The preparation described by Meyer was found in a man thirty-eight years of age. In this specimen the appendix of the ventricle passed upward as a cylindrical body, between the epiglottis and the inner surface of the thyroid cartilage. The appendix was situated directly beneath the mucous membrane of the false cord and the arytaeno-epiglottidean fold. It measured 2.5 cm. in length and 1.5 cm. in width. Connected to the appendix by a thin pedicle was a sac which, after piercing the thyrohyoid membrane, passed into the neck back of the thyrohyoid muscle, where it formed a large extralaryngeal pouch. This extralaryngeal pouch measured 2.8 cm. in length, 1.3 cm. in width and 1.0 cm. in depth. The left appendix passed 2.1 cm. above the upper border of the thyroid cartilage. Nothing otherwise abnormal was found in the larynx.

The extralaryngeal sac has, in most cases, communicated with the appendix of the ventricle by a constricted part which in some cases has been so narrow that it scarcely permitted of the insertion of a small bristle. Virchow evidently regarded the appendix of the ventricle as pathological, for he states that in addition to the tracheocele, there is found a diverticulum or process of the ventricle of the larynx which may be designated as a ventricular laryngocele. This is usually a thin sac which extends upward from the false cord to the upper border of the thyroid cartilage or even to the hyoid bone, where it ends in a bulbous expansion. This prolongation usually communicates with the ventricle by a narrow orifice. Virchow, when he described this so-called ventricular laryngocele, was apparently dealing with the normal appendix of the ventricle, but the term ventricular laryngocele may well be preserved and applied to the pathological condition under discussion, a cystic dilatation of the ventricular appendix.

LARYNGEAL DIVERTICULA

The appendix is, as a rule, placed vertical to the ventricle. The opening of the appendix is found upon the anterior and external part of the superior wall of the ventricle. To see this well the inferior cord must be depressed, so that the lower surface of the superior cord is exposed. When this is done an elongated fissure measuring from 5 to 8 mm is seen, which begins near the anterior extremity of the superior cord and terminates posteriorly at the junction of the anterior and middle third. The appendix lies within the thickness of the arytaeno-epiglottidean fold, between it and the thyroid cartilage. Its depth varies in different subjects, often there is a difference on the two sides. Usually the appendix does not reach the upper border of the thyroid cartilage. It may, however, extend as high as the hyoid, or so high that it is covered by the mucous membrane of the posterior part of the floor of the mouth. The interior of the appendix is usually divided into a number of small cavities by septa.

Three types of laryngeal diverticula are found (1) The extralaryngeal, (2) the combined—an extra- and intralaryngeal sac, communicating with each other, being present; (3) the intralaryngeal.

But fourteen cases of laryngeal diverticula which can be accepted without reserve after a critical examination of the data given concerning them have been observed clinically.

Extralaryngeal Diverticulum—In six of these the diverticulum has been entirely extralaryngeal. These cases have been observed by Pantaloni, Pearsall, Herhold, Scheven, Guggenheim and Burger. Four occurred in men and two in women, the patients being aged 25, 2, 24, 41, 29 and 12 years, respectively.

The extralaryngeal diverticulum offers few problems as far as surgery is concerned, for the sac can be easily removed by an operation which is wholly extralaryngeal and there is no tendency, apparently, to the formation of another extralaryngeal or of an intralaryngeal pouch.

The general characteristics of the extralaryngeal diverticulum is well illustrated by the case observed by Pantaloni. His patient, a young man twenty-five years of age, of athletic build, experienced a slight pain on the right side of his neck while carrying a heavy sack of flour up a flight of stairs. This pain did not prevent him from continuing his work, although it persisted for 4 or 5 days. Some time afterwards, while blowing, he noticed a swelling upon the right side of the neck, to which he attached no significance, for it was not painful and caused him no inconvenience. When he pressed upon the swelling a whistling sound could be heard. The swelling gradually increased in size, finally interfering with the motions of the head. He then consulted a physician.

When examined a tumor the size of a hen's egg, which occupied the entire submaxillary region, was found. It was not adherent to surrounding structures, but seemed to be connected with the thyroid cartilage. It had on palpation an elastic feel, and could be made to disappear upon pressure, when a sharp,

whistling sound, which evidently came from the larynx, could be heard. This tumor could be made to reappear by forced expiration. The larynx was normal upon laryngoscopic examination, the voice had not been interfered with, and respiration was free.

This mass was exposed by an incision parallel to the border of the lower jaw, at the level of the upper border of the thyroid cartilage. The sac, the size of a hen's egg, was carefully isolated, the submaxillary gland lying above, and the superior thyroid artery to the inner side. A small pedicle passed over the upper border of the thyroid cartilage, just to the right of the incisure. When the sac was opened a point of communication with the interior of the larynx, the size of a pin, was found. The pedicle was ligated and the wound closed in the usual way. There was no recurrence of this swelling after the operation.

This case with the sudden development of the swelling without hoarseness or interference with respiration is typical of the extralaryngeal diverticulum. In some instances the sac has caused so little inconvenience that surgical interference has not been deemed necessary.

Combined Types (Extra- and Intralaryngeal Diverticula)—The mode of development, symptoms, and difficulties encountered in treatment of the combined type are well indicated by the case observed by us

This patient, Mrs. W., age sixty-nine, was examined December 13, 1913. She complained of the following symptoms. Marked hoarseness and a sensation of fulness in the throat associated with a profuse discharge of foul-smelling pus which had to be coughed up almost constantly from the larynx. There was an external swelling in right side of the neck the size of a goose egg, located above and to the side of the upper border of the thyroid cartilage. While the escape of pus was in part spontaneous, large amounts of it could be expressed at once by pressing upon the external swelling in the neck. She was able in this way to evacuate as much as a fourth of a tumbler of pus at a time. This would relieve her for a while of the sensation of fulness in the throat and there would be a partial, but temporary, cessation of the discharge of pus. The annoyance occasioned by the loss of voice and sensation of fulness in the throat was slight as compared to the great suffering produced by the constant escape into the throat of quantities of foul pus. Her sleep was constantly disturbed because of the discharge of pus into the larynx which gave rise to paroxysms of coughing.

Since girlhood she had been subject to frequent attacks of hoarseness which usually came on once or twice a year and lasted sometimes as long as a week, associated usually with symptoms of cold in the head and pharyngitis, but for about twenty years she had been relatively free from attacks of this sort. Three years ago, however, while travelling in Ireland, she developed a hoarseness, associated with severe coughing spells. After one of these coughing spells, she experienced for the first time a sense of pressure and fulness in the throat, and a swelling developed rather suddenly in the right side of the neck in the posterior and lower part of the submaxillary triangle. There were periods when these sensations would



FIG 1 —The swelling occupying the posterior and lower part of the submaxillary triangle indicates the position of the extralaryngeal portion of the diverticulum. The scar resulted from an early operation during which a tracheotomy had to be performed because of œdema of the glottis. The attempt to remove the diverticulum was then given up. The swelling could easily be reduced by pressure. Pus was coughed up from the larynx and a peculiar whistling sound could be heard when pressure was applied. This is the typical position for true extralaryngeal diverticula.



FIG 2 —View of the intralaryngeal portion of the diverticulum which displaces the epiglottis to the left and covers the false cord upon the right side. The space between the cords is greatly reduced. The edge of the left true cord is visible.

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almost entirely subside, but they never disappeared completely. The hoarseness was always more or less relieved when the other symptoms subsided. On one occasion, while looking upward, with her head tipped back, the swelling in the neck collapsed and with this came immediate return of voice.

One year after the onset of the trouble, a swelling in the larynx was operated upon twice by one of our local laryngologists. The operation was followed by a collapse of the swelling in the throat and return of voice. The relief, however, was only temporary and the original symptoms soon returned. Two months after the last operation an infection of the throat occurred and since that time large quantities of foul smelling pus have been discharged from the sac into the larynx. After failure to get relief by intralaryngeal operations, she consulted general surgeons, one of whom attempted to give relief by external operation. What was done we do not know. A scar is found over the sac, the result of this operation, and a tracheotomy was also performed, undoubtedly because of an œdema of the glottis, secondary to an acute inflammatory process involving the intralaryngeal sac which developed at this time.

Intralaryngeal inspection disclosed a swelling about the size of a walnut, springing from the right side. The right side of the epiglottis was doubled over by pressure of the swelling external to the arytaenoid-epiglottidean fold. About two-thirds of the cavity of the larynx was filled by this mass which completely obscured the view of the right vocal cord and permitted only an occasional glimpse of the left cord. The surface of this intralaryngeal swelling was smooth and it could easily be indented. Some idea of the appearance of the swelling in the larynx can be had from a drawing made from inspection of the larynx by means of a laryngeal mirror (Fig. 2). The appearance of the external swelling in the neck is shown in Fig. 1.

The diagnosis of a combined laryngeal diverticulum was made. An operation was performed in December, 1913, with the idea of removing the external sac, which occupied the lower posterior part of the submaxillary triangle. The large sac, the size of a goose egg, which was filled with pus could easily be dissected free from the surrounding structures, notwithstanding that a previous operation had been attempted but given up because the patient had so much difficulty in breathing that a tracheotomy was necessary. The constricted communication between the external and internal sacs was the size of a lead pencil and passed over the upper border of the thyroid cartilage through the thyrohyoid membrane about 2 cm. posterior to the incisura. When the external sac was removed the cavity of the internal could be easily seen. It was decided at this time to attempt removal of the internal portion by intralaryngeal methods. After splitting the thyroid cartilage somewhat, just anterior to its right upper horn, the tissues forming the wall of the sac were freed and inverted by suture. The hole in the thyrohyoid membrane was repaired and the wound closed in the usual way, drainage being inserted because of the infection in the extralaryngeal sac.

There was a decided improvement in the voice, the sensation of fullness in the throat was less noticeable, and the amount of pus discharged

from the larynx was much less. On January 9, under cocaine anæsthesia, an attempt was made to reduce the size of the intralaryngeal swelling. An attempt was made to open the intralaryngeal pouch from below upward throughout its entire extent. This was accomplished by using a hook-shaped laryngeal knife. The knife was introduced into the larynx and caught in the lower part of the swelling and by withdrawing the instrument from the larynx the pouch was split to its upper surface. There was an immediate collapse of the cyst and a return of the voice. By using the Krause laryngeal double curette, the edges of the incision were removed piece by piece, until an opening about one-half inch wide had been made. The operation lasted about an hour, as a delay occurred after each step because of bleeding which provoked coughing as long as it kept up.

The improvement in symptoms was marked for a few weeks, but later the symptoms—hoarseness, coughing up of pus, and the expression of air from the sac—recurred to some extent. It is evident that a complete removal of the laryngeal pouch by an intralaryngeal operation is not feasible, for if any of the pouch remains it, as we should expect, fills with pus. The amount of improvement in the patient's voice has not been as much as we had hoped for. On the other hand, the improvement in the most annoying symptom, the secretion of pus into the larynx, has been great. The patient is now able to sleep without being constantly awakened by the secretion of pus. The size of the pouch in the larynx is about one-third what it was before the effort was made to remove it by the intralaryngeal operation.

Five other cases of combined laryngeal diverticula have been reported by Ledderhose, Beausoleil, Benda and Borchert, Avellis and Reich. Three of these occurred in the male, two in the female sex. The ages of the patients being 58, 50, 43, 41 and 30 years, respectively. Benda and Borchert's patient was 43 years old. He had been hoarse for 27 years, but had never had any difficulty in breathing. He had delirium tremens and while struggling violently, he suddenly became cyanotic and died.

At the autopsy the vestibule of the larynx was found to be filled by a hemispherical mass lying in the left aryæno-epiglottidean fold and the left false cord. The swelling was soft, could be made to disappear upon pressure, and filled again spontaneously and rapidly, if the laryngeal cartilages were separated. If a probe was introduced into the left ventricle, it passed apparently under the sinus pyriformis and then upward and lateralward to the base of the tongue. The length of the entire diverticulum was $4\frac{1}{2}$ cm, the intralaryngeal pouch measuring $2\frac{1}{2}$ cm. The width of the intralaryngeal pouch was $1\frac{1}{2}$ cm, that of the extralaryngeal pouch $2\frac{1}{2}$ cm.

This patient evidently died as the result of sudden distention of the diverticulum during violent muscular exertion, while being restrained. It is the only case recorded in which the diverticulum has become distended so much that it has occluded the vestibule of the larynx. In the case reported by us a tracheotomy was performed at one time, but apparently in this instance an œdema of the glottis had developed as the result of an acute inflammatory process in the diverticulum.

The symptoms associated with the combined type of diverticulum are caused by the intralaryngeal pouch, which lies in the arytaeno-epiglottidean fold and encroaches upon the vestibule of the larynx. The operative procedures attempted in removal of this pouch have varied. Some of the intralaryngeal operative procedures have been unsatisfactory. As the intralaryngeal pouch is the cause of the symptoms and renders surgical interference difficult and often unsatisfactory, those cases in which there has been an intralaryngeal diverticulum without an extension externally through the thyrohyoid membrane may be considered with the combined type.

Intralaryngeal Diverticulum—Three cases of intralaryngeal diverticulum have been observed. These cases have been reported by Schrotter, Labarre and Hippel. In Schrotter's case the changes developed early and he speaks of it as a congenital abnormality of the larynx. The patient was a boy 8 years old. His voice acquired a peculiar metallic ring after an attack of scarlet fever. The intralaryngeal diverticulum in this case was bilateral. A number of different procedures were attempted in the treatment and finally the false cords and the diverticula were cut during forced expiration by a scissors-like instrument with hooked blades. Afterward pieces of the wall of the diverticula were removed at different times. Finally the right half of the larynx was in good order and the conditions on the left side were satisfactory, although the greater part of the false cord on this side had been removed. The voice was not improved much. It remained much the same as before the operation.

Labarre's patient was a nun, aged thirty. Since youth her voice had been rough without known cause. After an attack of tracheo-bronchitis her voice was much impaired. Breathing was not interfered with much during the day, but at night she had suffocative attacks which became so severe that she was given a night watch in the cloister. Laryngoscopic examination revealed a mass the size of a wild plum which had apparently developed at the expense of the arytaeno-epiglottidean fold and was fused with the base of the same. This mass, which covered a large part of the vestibule, extended beyond the median line and almost reached the opposite wall of the larynx. The size of the mass did not vary much during the different phases of respiration, and because of this the lesion was regarded as a cyst of the arytaeno-epiglottidean fold.

The mass was punctured with a galvanocautery but no fluid escaped and the size did not change. The mass was then divided with a loop of a galvanocautery and the correct diagnosis made. The voice became normal immediately after the operation and since then the patient has had no trouble with voice or respiration.

Hippel's patient was a woman, thirty-four years old. When she was 14 or 15 years of age, she had at times spells of coughing when she became hoarse. During the periods when she was free from coughing the voice was clear, but rougher and deeper than a woman's voice at her period of life should be. When 23 years old she became very hoarse, and during the night developed a stridor. Respiration was free, although there was some difficulty on deep breathing and exertion. The patient at this time visited the surgical clinic and an incision was

made, apparently intralaryngeal, which permitted of the escape of pus. A few years afterward these same symptoms were repeated and an abscess was again opened by an intralaryngeal procedure. When examined December 26, 1909, by Dr. Weyl, the lymph-nodes upon the left side of the neck were somewhat enlarged and when pressure was made there was some discomfort, but not any marked tenderness. Laryngoscopic examination revealed upon the left side of the larynx a large mass, which filled the greater part of the lumen of the larynx and appeared to develop from the neighborhood of the left arytenoid cartilage. The aryteno- and pharyngo-epiglottidean folds were obliterated and the pyriform sinus could not be seen. The mass apparently passes over into the lateral wall of the pharynx. Nothing can be seen of the left cord. A probe revealed that the mass was tense and its surface smooth, like a cyst.

The diagnosis of suppurative inflammation of the left arytenoid cartilage with abscess formation was made. An incision was made into the mass under local anæsthesia, and a large quantity of foul, blood-stained, thin pus escaped.

An examination made on December 28, 1909, revealed that the conditions within the larynx had improved somewhat. The true and false cords on the left side could not, however, be differentiated from each other, and they apparently did not move during attempts at phonation. The right cord compensated by swinging across the median line. During the next few days, in spite of frequent irrigation and gargling with hydrogen peroxide, the *foetor ex ore* continued, the swelling became more marked, the region about the left arytenoid cartilage was discolored gray, resembling somewhat gangrene.

As the condition had not been improved by repeated intralaryngeal operations and there was danger of an acute œdema of the glottis, it was thought best to perform a laryngofissure.

On January 28, 1910, a low tracheotomy was performed, which was made difficult by large dilated veins. A tampon cannula was inserted through which the anæsthetic was administered. The median incision was then continued upward to the hyoid and the anterior surface of the thyroid cartilage was exposed. The thyroid and cricoid cartilages were then divided in the median line and the two parts were separated by retractors. The region of the left vocal cord was then found to be occupied by a large hemispherical mass, with a broad base which completely covered the ventricle so that the opening into this could not be found. The mucous membrane covering the mass was highly reddened and bled profusely when touched. The mucous membrane was then painted with a 20 per cent novocaine-suprarenin solution to render it insensitive and reduce the amount of bleeding. The larynx below the glottis was tamponed with iodoform gauze and the mass incised parallel to and the length of the false cord. A half teaspoonful of foul-smelling pus was discharged. The incision was prolonged over the arytenoid cartilage to determine whether the cartilage was necrotic or a foreign body present. Neither was found. When the edges of the incision were retracted a cavity the size of a walnut lined with mucous membrane was found. This cavity extended below to the lower border of the thyroid cartilage, above to the base of the tongue, laterally it was limited by the thyroid cartilage, and posteriorly it encroached upon the median line of the larynx. The cavity was oval in shape, folds of mucous membrane projecting into it from the walls of the cavity.

Enucleation of the sac from the cavity of the larynx was considered im-

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possible Therefore a strip of iodoform gauze was packed in the cavity and another was introduced into the cavity of the larynx The cricoid cartilage was closed by suture and the thyroid gland which had been displaced downward was placed over the suture line The tampon cannula was replaced by an ordinary one and the wound closed

It was soon discovered that it would be impossible to close this cavity by packing and intralaryngeal methods Besides the tracheotomy tube had caused an erosion of the trachea It was decided therefore to attempt removal of the sac On February 9 the tracheotomy tube was removed There was no disturbance of respiration and the patient could phonate moderately well

On February 28 the patient was again anesthetized, an incision was made to the left of the median line, which extended from the hyoid bone to the cricoid cartilage The infrahyoid group of muscles was divided transversely, the thyroid cartilage was divided longitudinally, and both the thyrohyoid and cricothyroid ligaments were incised to permit of retraction of the cartilage outward The space between the thyroid cartilage, the laryngeal mucous membrane and pharynx was thus exposed. It was difficult to differentiate tissues, because of profuse hemorrhage from numerous capillaries, and attempts to aspirate pus from the diverticulum were unsuccessful Finally, Hippel succeeded in opening the sac It was empty and presented much the same appearance that it did at the first operation, the cavity being lined by a highly reddened mucous membrane thrown into numerous folds

Posteriorly and laterally the sac rested upon the pharyngeal wall, medially and posteriorly it was related to the mucous membrane of the larynx, anteriorly and laterally it rested upon the thyroid cartilage. In the last position the sac was dissected free with great difficulty The pharyngeal wall was torn in two places during removal of the sac, but immediately closed About $\frac{1}{4}$ of the sac was so adherent that it was allowed to remain, the mucous membrane being removed with a curette. The upper and lower lips of the opening into the larynx remained and these were sutured so as to exclude the remaining cavity from the interior of the larynx The cavity remaining after removal of the diverticulum was packed with iodoform gauze which was brought down below the thyroid cartilage into the neck The cartilage was then sutured and the wound closed

The patient made a good recovery from the operation When examined on May 17 the voice was strong but rough Laryngoscopic examination revealed no evidence of reformation of the diverticulum The right half of the larynx was normal The vocal cord could be seen throughout its entire extent The left true and false cords could be differentiated and the slit-like entrance to the ventricle could not be found

But two cases, besides our own, of combined laryngeal diverticulum have been subjected to operation Ledderhose's patient was a man fifty-eight years of age, whose voice had always been rough. Two years before consulting a physician he noticed a small swelling near the larynx which could be made to disappear by pressure By firmly binding a cloth about the neck this swelling could be in greater part held back When the swelling developed in the neck the hoarseness increased, a cough developed, and mucus expectoration was noted There also developed difficulty in swallowing, particularly of fluids, part of which was regurgitated through the nose At night, especially when lying

upon the right side, in which position the swelling in the neck filled, dyspnoea was apt to develop, and because of this the swelling had to be frequently emptied. During forced expiration there developed in the right thyrohyoid region a tympanitic swelling the size of a child's fist, which extended above somewhat beyond the hyoid, anteriorly nearly to the median line, posteriorly to the sternocleidomastoid muscle, and below to the cricoid cartilage. It could be made to disappear by pressure, at which time was noted a loud gurgling, splashing sound. The opening in the thyrohyoid membrane could be felt with the palpating finger when the swelling was not tense. Laryngoscopic examination revealed upon the internal wall of the larynx a broad based, flat, rounded mass, which originated in the right arytaeno-epiglottidean fold and hung over the rima glottidis, extending almost to the left wall of the larynx. When pressure was made upon the external sac this swelling moved to the left, and regained its former position when the pressure was removed. When the external sac was emptied, the internal one barely reached the median line and was reduced almost one-half in size. The mucous membrane covering this swelling was reddened. The false cord was not visible. The point of communication of the external sac with the interior of the larynx could not be determined on laryngoscopic examination.

Because of the marked symptoms Lucke removed the external sac. This was easily separated from the surrounding tissues, except on the anterior surface of the right half of the hyoid. At the point of exit of the sac through the thyrohyoid membrane, the communication with the interior of the larynx being the size of a finger, the pedicle was ligated and then closed by layer sutures.

After this operation the laryngoscopic picture was not changed. Six weeks later the point at which the external sac pierced the thyrohyoid membrane was firmly closed, but the intralaryngeal sac had become larger, so that it completely overlapped the cords. Numerous attempts were made to puncture the sac by intralaryngeal methods. At one time several drops of a clear, thick, gelatinous material were obtained, but usually only blood and air. The swelling decreased one-third in size, the left cord became visible, the symptoms were less marked and the patient was discharged.

Four and one-half years later the patient returned because of marked dyspnoea. At night the patient had attacks which were suffocative in character. Examination showed that there was no reformation of the external sac. The intralaryngeal sac extended over the median line. A fold of mucous membrane, which during respiration floated up and down, extended from the posterior part of the base of the swelling over the right arytenoid cartilage.

An operation was performed to remove the intralaryngeal sac. After a tracheotomy had been performed and a tampon cannula inserted, the larynx was divided throughout the entire length. The sac which lay at the border of the epiglottis was collapsed. It was ligated at the base and cut away. The extirpated portion corresponded to the part which hung over the vocal cords into the cavity of the larynx. The outer wall of the diverticulum lay upon the inner surface of the thyrohyoid membrane. The remaining portion of the diverticulum could easily be separated from the surrounding tissues. A narrow process of the sac extended backward to the arytenoid cartilage and was dis-

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sected out This process was in the fold of mucous membrane which was seen posteriorly in the laryngoscopic examination

Following the operation there was some necrosis of the margins of the thyroid and only a small part of the right vocal cord could be seen posteriorly The greater part was obscured by the false cord, and during phonation the cord did not reach the median line The voice remained rough and hoarse, but respiration was free

Reich has recently reported a case of combined diverticulum which was operated upon successfully His patient, a woman aged thirty, could speak normally and even sing, up to the autumn of 1912 During October and November of this year hoarseness developed without known cause The degree of hoarseness varied and during the following March there were eight days during which a marked improvement was noted Since that time, however, the hoarseness has remained unchanged and has been so marked that the patient had to make an effort in order to make those about her understand There was no difficulty in swallowing There is usually no dyspnoea, but in recent times there has been considerable dyspnoea when the patient makes an extra effort, and this has been increasing The patient has had no cough and has had no trouble with expectoration

In October, 1912, when the hoarseness came on, a swelling developed in the right side of the neck which increased slowly in size and caused but little inconvenience This swelling occupied the posterior and lower part of the submaxillary triangle It extended upward to the lower border of the mandible, posteriorly to the anterior border of the sternocleidomastoid, anteriorly to within two fingers' breadth of the median line, and below to the upper border of the thyroid cartilage The tumor was the size of a hen's egg When pressure was made upon this swelling, the intralaryngeal mass was not greatly reduced in size, but it was displaced toward the left side of the larynx

The external sac was aspirated and the 20 c c of air removed The external swelling then disappeared completely and the intralaryngeal one collapsed, so that during attempts at phonation the entire free border of the right cord could be seen and its movements were perfectly normal A quarter of an hour after aspiration without any effort on the part of the patient, both the extra- and intralaryngeal sacs had filled The X-ray revealed the extent of this air-containing sac

The laryngoscopic examination revealed a broad based swelling, which developed from the right false cord It was about the size of a cherry and hemispherical During quiet breathing this mass completely covered the right vocal cord and during phonation it extended beyond the median line and touched the false cord on the opposite side A small part of the right vocal cord could be seen posteriorly near the arytenoid cartilages A part of the left vocal cord was also covered during phonation The entrance to the ventricle could not be found The surface of the swelling was smooth, reddish-yellow in color and injected The mucous membrane presented no evidences of any marked inflammatory changes The sinus pyriformis on each side was deep The size of the swelling did not change during phonation The left side of the larynx was normal

The operation was performed under pantopon-scopolamine and $\frac{1}{2}$ per cent novocaine-adrenalin anaesthesia A transverse incision, which extended from the

anterior border of the sternocleidomastoid muscle to a little beyond the median line, was made over the extralaryngeal diverticulum. The anterior part of this incision was later carried down to the middle of the thyroid cartilage. The external diverticulum was readily exposed after the superficial structures had been divided. The submaxillary gland was directly above the sac, and below the gland were the posterior belly of the digastric, the hypoglossal and superior laryngeal nerves and the hyoid bone. Lateralward the sac extended to the anterior border of the sternocleidomastoid, below it extended a little beyond the upper border of the thyroid gland, and medianward it passed beneath the thyrohyoid muscle. After transverse division of the omo-, sterno- and thyrohyoid muscles and exposure of the anterior surface and upper border of the thyroid cartilage, a pedicle the size of the little finger, the communication between the external and internal sacs, was found. This passed through the thyrohyoid membrane $1\frac{1}{2}$ cm lateralward to the incisura thyroidea. The membrane was incised and the pedicle dissected free. Then by making traction upon the external sac and pedicle, the internal sac was separated, partly by blunt, partly by sharp dissection from the structures in the aryteno-epiglottidean fold. When traction was exerted upon the pedicle dyspnoea developed and the patient became nervous. During the dissection an opening was evidently made into the ventricle, for during forced expiration air was expelled. A fold of mucous membrane, evidently part of the false cord, floated into the interior of the larynx, interfering with respiration. This was sutured to the upper border of the thyroid cartilage. The wound was closed by layer sutures, a small drain being placed down to the thyrohyoid membrane in order to prevent an emphysema, if the sutures would not hold.

The recovery was complete. The voice is the same as before the development of the diverticulum and respirations are free.

The cases observed by Beausoliel and Avellis were not operated upon. The patient observed by Beausoliel was a male, aged fifty. For five years nasal breathing had been difficult. At times the nasal passages were completely occluded. For three years he had had a long continued bronchitis, associated with severe attacks of coughing which resisted treatment. One and a half years after the beginning of the attacks of coughing the voice became rough and a small swelling was noted upon the right side of the neck, somewhat in front of and below the great wing of the hyoid bone and 4 cm behind the incisura thyroidea. Upon laryngoscopic examination a swelling covered with reddened mucous membrane, measuring 1 cm in length and $\frac{1}{2}$ cm in width, was found in the right aryteno-epiglottidean fold. At first sight this appeared like a true eversion of the ventricle.

The nasal polypi were removed in this case. The diverticula were not touched.

Avellis' patient was a girl, aged four years. The size of the extralaryngeal diverticulum is the most interesting feature of this case. When the child cried there slowly appeared, first upon the right, then upon the left side, near the thyroid cartilage, a soft tympanic swelling, which extended upward to the lower border of the mandible, below almost to the clavicle. There was no respiratory difficulty. Operation was postponed as there were no indications at the time of examination for removal of the sacs.

Median laryngoceles have been described by Hutchinson, Madelung, Courtil-

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lier and Pelletier These have all probably been secondary to an inflammatory process in the larynx, which has resulted in a perforation of the larynx leading to a localized emphysema In three of the cases there have been distinct evidences of tuberculosis In Madelung's case the walls of the swelling were composed of degenerated muscles, infiltrated with tuberculous granulation tissue, and in Pelletier's case there were also distinct evidences of tuberculosis in the sac In the case reported by Courtillier there was neither mucous membrane or endothelium upon the interior of the sac.

Meyer has found in the lower apes a median air sac which varies considerably in size The opening into this sac is usually found at the base of the epiglottis From this a funnel-shaped depression passes over the incisura thyroidea, which expands to form a sac which lies anteriorly between the hyoid bone and thyroid cartilage

No case of a diverticulum the analogue of the median air sac in the lower apes has been described in man, and the median diverticula cannot be regarded as true diverticula, in which the lining is formed by the mucous membrane of the larynx.

(1) The sudden formation of the diverticula and the early age at which symptoms often develop, would indicate that they are probably congenital, and that they are analogous to the lateral air sacs found in howling monkeys

(2) The true diverticula are constant in their position, appearing either as the extralaryngeal, intralaryngeal, or combined type. The extralaryngeal sac can be removed easily, as in most cases the pedicle is small and there is little or no intralaryngeal prolongation.

(3) The intralaryngeal and combined types are best treated by excision In cases in which the intralaryngeal sac cannot be enucleated after incision of the thyrohyoid membrane, the thyroid cartilage may be split longitudinally in front of the superior horn By this method the enucleation of the internal sac can be made practically extralaryngeally.

Intralaryngeal methods, consisting of splitting of the sac and partial removal of the wall, are unsatisfactory, for the posterior extension of the sac is removed with difficulty if at all. Air and pus collecting within this extension causes a recurrence of symptoms.

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THE RONTGENOLOGIC DIAGNOSIS OF SURGICAL LESIONS OF THE STOMACH AND DUODENUM *

BY GEORGE EMERSON BREWER, M D.

AND

LEWIS GREGORY COLE, M D

OF NEW YORK CITY

THE object of this communication is to report a series of cases furnishing data which may help to solve two important questions:

First, is there reason to believe from our present experience that the Rontgen ray will eventually prove as valuable for the diagnosis of surgical lesions of the stomach and duodenum as for the diagnosis of fractures and urinary calculi?

Second, what method of Rontgen examination gives the most accurate results? In the first question it will be noted that we have used for comparison only the diagnosis of fractures and urinary calculi. While rontgenology has proved of great assistance in the solution of many diagnostic problems, such as joint and bone diseases, pulmonary tuberculosis, aneurisms, sinus infections, etc., the surgeon accepts the rontgenographic evidence of fractures and renal and ureteral calculi as final, and of greater value than the clinical history or the results of a most painstaking physical examination, or both methods combined. As a result of the accuracy with which these lesions are recognized by skilled rontgenologists, few if any experienced surgeons of the present day will accept the responsibility of treating a complicated fracture or of advising surgical intervention in a case of urinary calculi without the aid of a rontgenologic examination, if it is possible or practicable to obtain one.

What then is the present status of rontgenology in surgical lesions of the stomach and duodenum? A brief review of the history and development of gastro-intestinal rontgenology may help to answer this question.

The first report on rontgenographic examination of the human stomach was published by Hemmeter in 1896¹. Early rontgenograms of the stomach were blurred and unsatisfactory, because long exposures were required. The fluoroscopic screen was therefore the more success-

* Read before the American Surgical Society, April 9, 1914.

¹ Hemmeter. Photography of the Human Stomach by the Roentgen Method, Boston Med and Surg Jour, p 609, June 18, 1896.

ful method until instantaneous rontgenograms were made possible by the advent of the intensifying screen. Not long afterwards, Kaestle, Rieder and Rosenthal² reported their biorontgenographic observation of the gastric motor phenomena, but subsequent publications fail to show that they have taken advantage of this valuable method for practical diagnosis. Inspired by their work, we started by making 12 rontgenograms in rapid succession. This number has been gradually increased until now we always make 40 and usually 50 or 60 rontgenograms in several series, with the patient in various postures, and at intervals of two hours, until the stomach is empty, a method to which the name serial rontgenography has been applied. These rontgenograms are studied individually and collectively and superimposed upon each other for comparison, or reproduced cinematographically.

Recently we have perfected a true rontgenocinematographic machine capable of making 50 rontgenograms of a single cycle, or 200 rontgenograms of the progression of an individual peristaltic contraction from the fundus to the pylorus in a 4-cycle type of stomach. The information gained by such an examination or by serial rontgenography includes

Size, position and shape or type of the stomach

Activity of the peristalsis, and width of the peristaltic contractions

Character of the systole and diastole

Depth of the rugæ and the direction in which they run

Degree of dilatation, and the motor phenomena of the descending and horizontal duodenum

Pyloric sphincter, whether clear-cut and well defined on both surfaces and $\frac{3}{16}$ inch wide, or irregular in contour and wider than normal

Cap (pilleus ventriculi), whether symmetrical, corresponding in size and contour with the pars pylorica, or invisible, deformed, or spasmodically contracted

The first inch and one-half of the gut, beyond the pyloric sphincter, viz, the cap (pilleus ventriculi), is stomach and not duodenum, considered embryologically, histologically, physiologically, anatomically and surgically. The cap is the most important portion of the whole gastric tract, and its rontgenologic appearance is of inestimable value in the diagnosis of lesions in the right hypochondrium.

The diagnosis of extensive gastric lesions is based on permanent filling defects in the walls of the stomach or cap, whereas the diagnosis of early lesions, particularly of small, indurated ulcers and adhesions, is based on the interruption of peristaltic contractions as they progress

² Kaestle, Rieder and Rosenthal. The Bioröntgenography of the Internal Organs. Arch. of the Roent Ray, June, 1910, p. 3

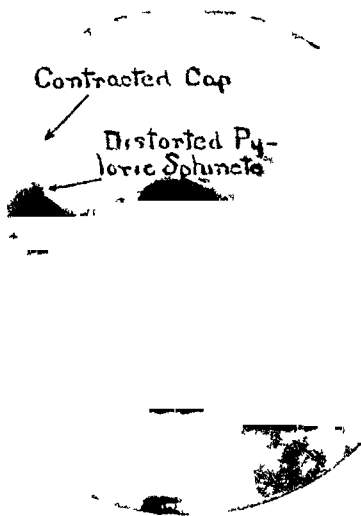


FIG 1—Clinical diagnosis Ulcer of the cap
Röntgenologic diagnosis Ulcer of the cap
Surgical findings Ulcer of the cap Case I

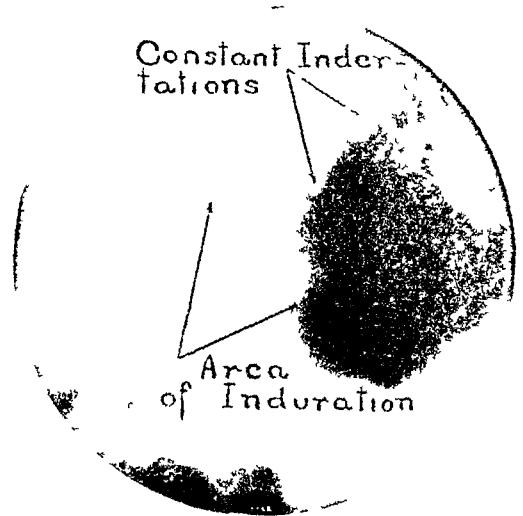


FIG 2—Clinical diagnosis Gastric ulcer
Röntgenologic diagnosis Gastric ulcer, with extensive induration, extending along greater and lesser curvatures of entire pars pylorica
Surgical findings Massive gummatous induration, occupying pyloric extremity of stomach and extending from greater to lesser curvature Chronic ulcer Case II

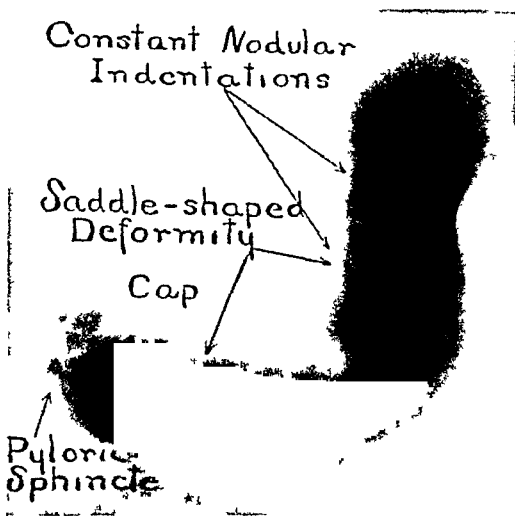


FIG 3—Clinical diagnosis Gastric cancer
Röntgenologic diagnosis Extensive carcinoma, involving entire lesser curvature
Surgical findings Extensive carcinoma, involving most of lesser curvature Case III

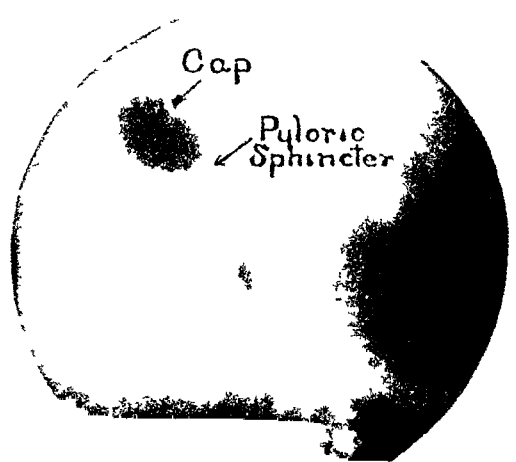


FIG 4—Clinical diagnosis Ulcer of the cap
Röntgenologic diagnosis Normal stomach and cap
Surgical findings Normal stomach and cap Case IV

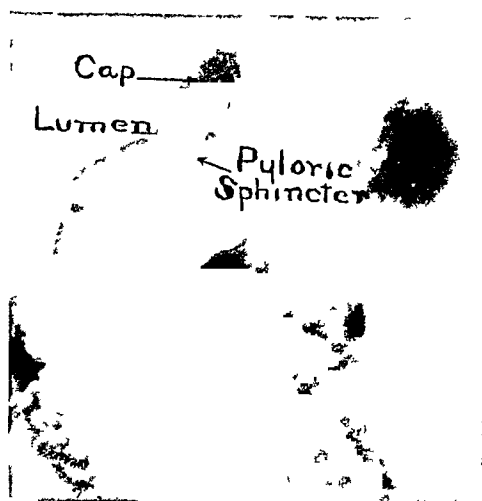


FIG 5—Clinical diagnosis Ulcer of the cap
Röntgenologic diagnosis Normal stomach and cap
Surgical findings Normal stomach and cap, diseased appendix Case V

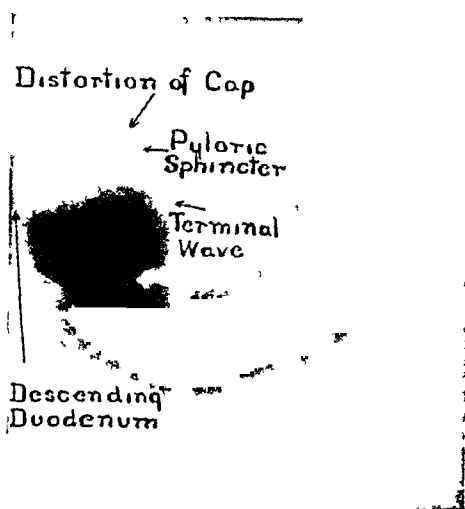


FIG 6—Clinical diagnosis Gall-bladder infection
Röntgenologic diagnosis Gall bladder adhesions involving the cap
Surgical findings Gall-bladder adhesions involving the cap Case VI

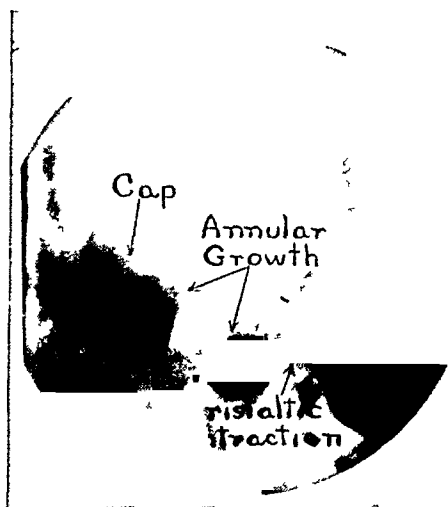


FIG 7—Clinical diagnosis Gastric carcinoma
Röntgenologic diagnosis Carcinoma involving pars pylorica more extensive on the lesser curvature
Surgical findings Carcinomatous induration involving the pylorus and extending along the lesser curvature Case VII

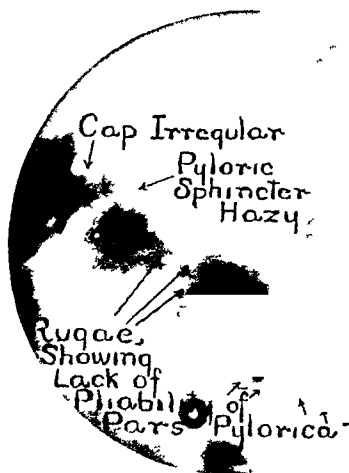


FIG 8—Clinical diagnosis Ulcer of the cap
Röntgenologic diagnosis Lack of normal expansion and contraction of gastric walls due to some functional disturbance Case VIII

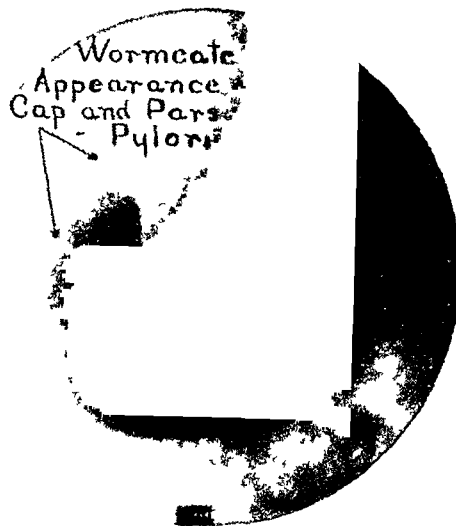


FIG 9—Clinical diagnosis Intestinal obstruction Röntgenologic diagnosis Gall-bladder infection with a calculus, causing adhesions involving pars pylorica Surgical findings Gall-stone obstructing upper part of jejunum, cholecystitis Case IX

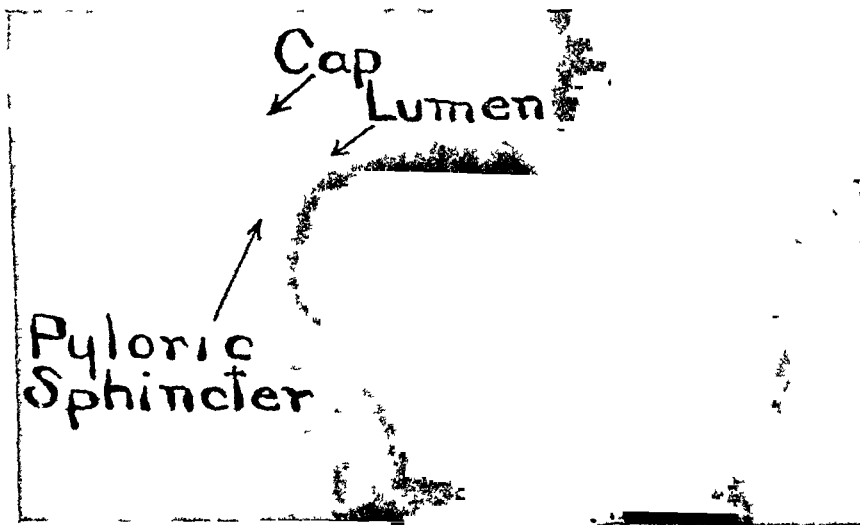


FIG 10—Clinical diagnosis Ulcer of the cap Röntgenologic diagnosis Spasm of cap and pars pylorica No organic lesion of stomach or cap Surgical findings Normal stomach and duodenum Case X

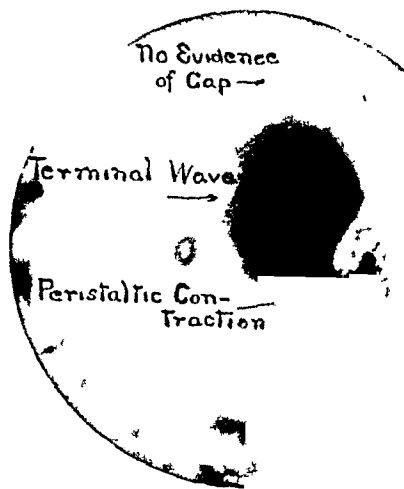


FIG 11 —Clinical diagnosis Ulcer of the cap
Rontgenologic diagnosis Ulcer of the cap
Surgical findings Ulcer of the cap Case XI

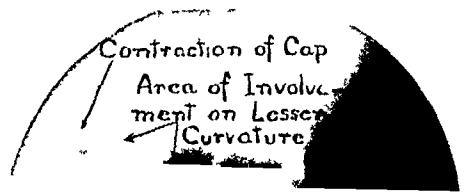


FIG 12 —Clinical diagnosis Ulcer of the cap
Rontgenologic diagnosis Ulcer of the cap, with adhesions involving the pyloric sphincter and lesser curvature of pars pylorica
Surgical findings Ulcer of the cap with dense induration extending for a short distance along lesser curvature of stomach Case XII

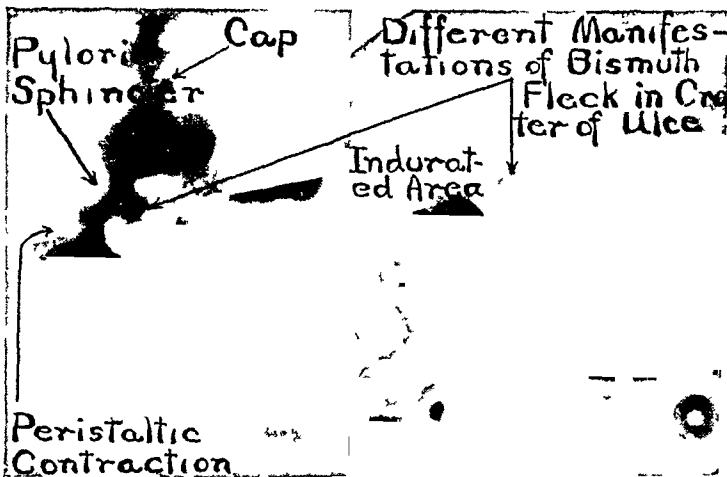


FIG 13 —Clinical diagnosis Gastric or duodenal ulcer
Rontgenologic diagnosis Ulcer of the gastric side of the pyloric sphincter most of the induration involving the stomach on the lesser curvature although the cap also is encroached upon
Surgical findings Induration of the cap near the pylorus with slight thickening along lesser curvature of stomach for three-fourths of an inch Case XIII

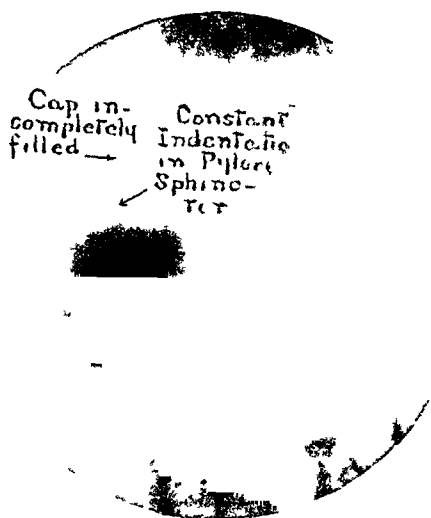


FIG 14 —Clinical diagnosis Ulcer of the cap
Röntgenologic diagnosis No evidence of gastric or duodenal lesion Surgical findings Normal stomach and cap Case XIV

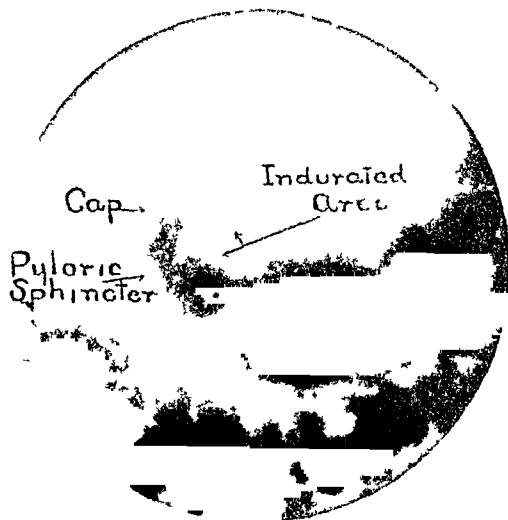


FIG 15 —Clinical diagnosis Ulcer of cap or stomach Röntgenologic diagnosis Minute ulcer, with induration involving cap pyloric sphincter and lesser curvature of pars pylorica Surgical findings Small shot-like induration on duodenal side of pylorus Case XV

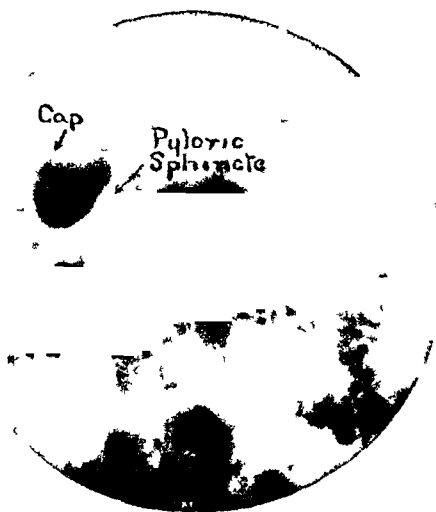


FIG 16 —Clinical diagnosis Definite ulcer of the cap Röntgenologic diagnosis Normal stomach and cap Surgical findings Normal stomach and cap Case XVI

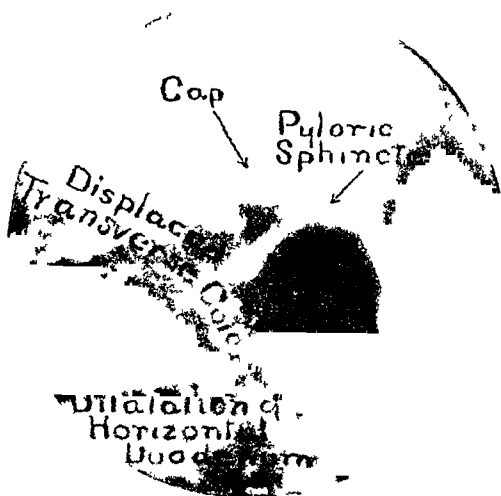


FIG 17 —Clinical diagnosis Definite ulcer of the cap Röntgenologic diagnosis Obstruction at duodenojejunal junction Displacement upwards of transverse colon by tumor mass Surgical findings Obstruction at duodenojejunal junction by enlarged tuberculous retroperitoneal glands Case XVII

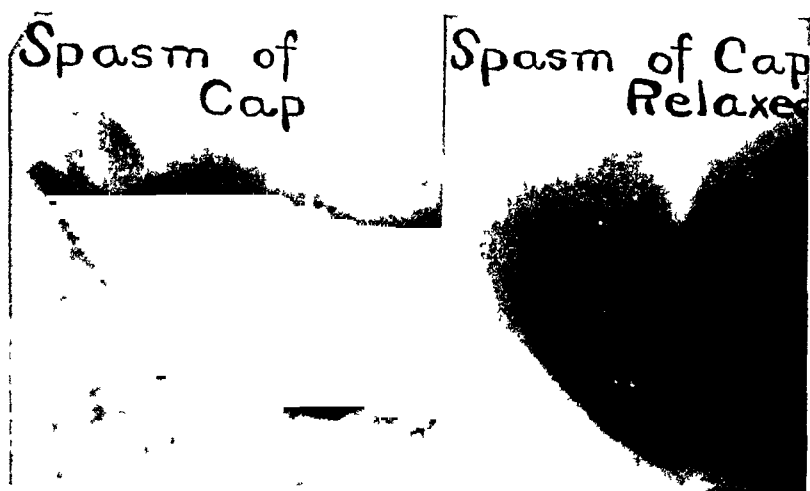


FIG 18 —Clinical diagnosis Ulcer of the cap Röntgenologic diagnosis Spasmodic constriction of the cap Surgical findings Normal stomach and cap, diseased appendix Case XVIII

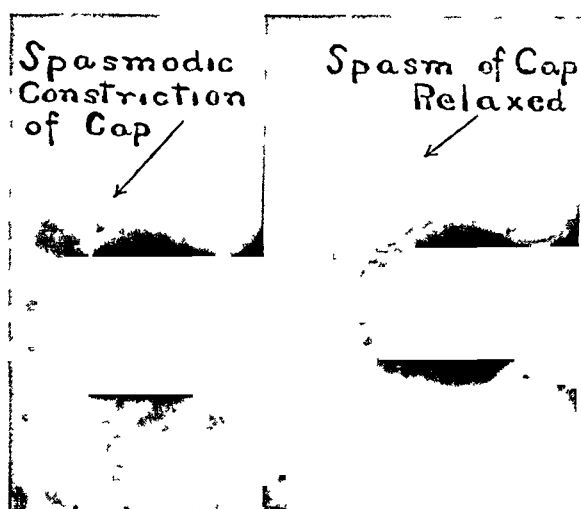


FIG 19 —Clinical diagnosis Perforated gastric ulcer Röntgenologic diagnosis Spasmodic constriction of cap caused by acute angulation in first portion of transverse colon No organic lesion of stomach or cap Surgical findings Normal stomach and cap Adhesions of ascending colon Case XIX

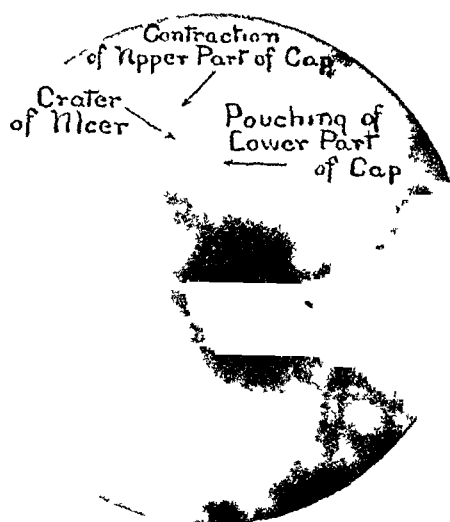


FIG 20—Clinical diagnosis Gastric ulcer four inches from pylorus. Röntgenologic diagnosis Ulcer of the cap. Surgical findings Ulcer of the cap. Case XX.

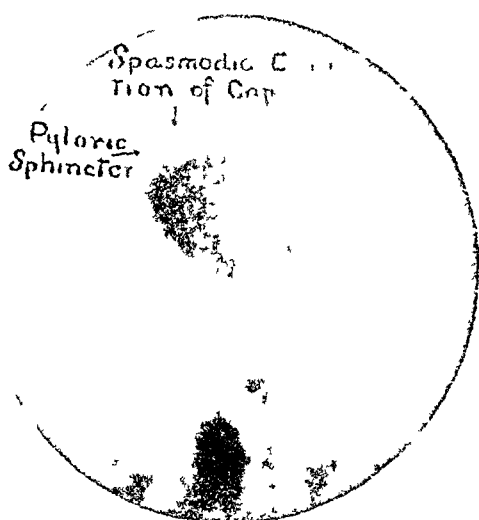


FIG 21—Clinical diagnosis Ulcer of the cap. Röntgenologic diagnosis Ulcer of the cap. Surgical findings Normal stomach and cap, diseased appendix. Case XXI.

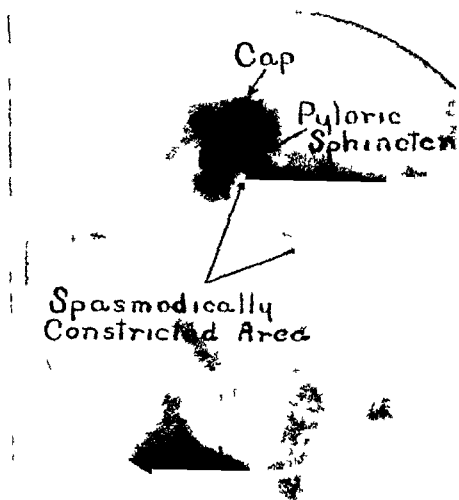


FIG 22—Clinical diagnosis Ulcer of stomach or cap. Röntgenologic diagnosis Annular lesion of pars pylorica. Surgical findings Normal stomach and cap. Case XXII.

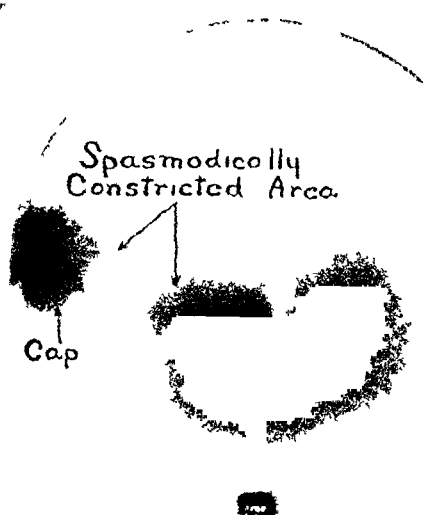


FIG 23—Another manifestation of spasm of pars pylorica, which presented in Case XXII.

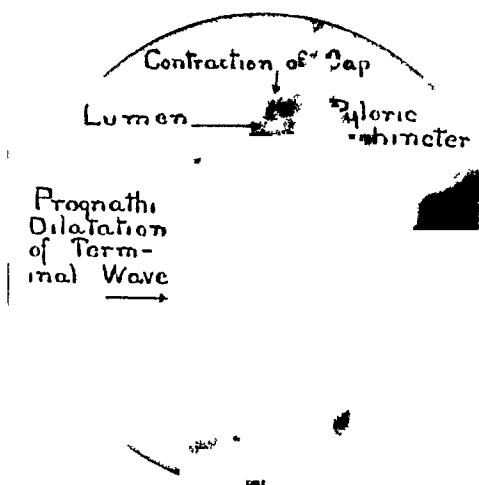


FIG 24 —Clinical diagnosis Ulcer of the cap
Röntgenologic diagnosis Ulcer of the cap
Surgical findings Ulcer of the cap Case XXIII

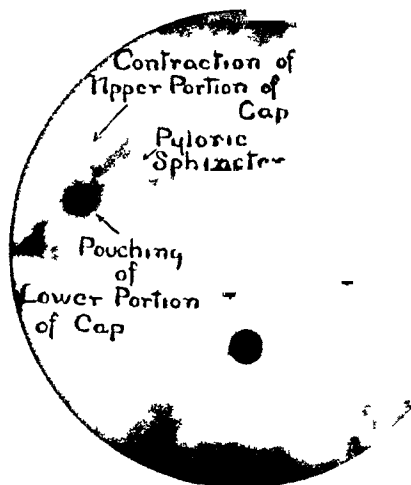


FIG 25 —Clinical diagnosis Ulcer of the cap
Röntgenologic diagnosis Ulcer of the cap
Surgical findings Ulcer of the cap Case XXIV

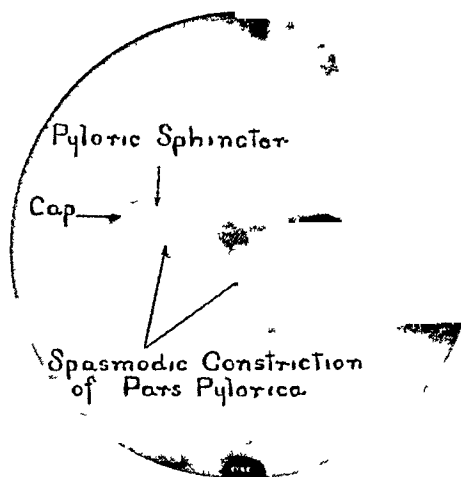


FIG 26 —Clinical diagnosis Gastric or duodenal lesion
Röntgenologic diagnosis Spasmodic constriction of cap and pars pylorica
Surgical findings Normal stomach and duodenum Case XXV

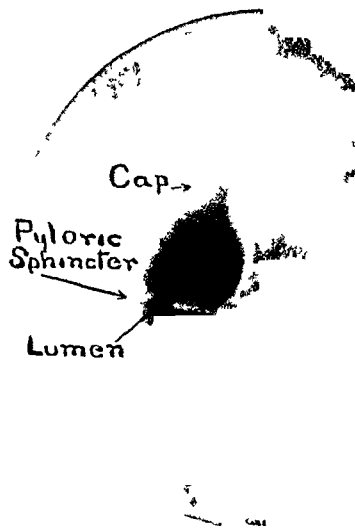


FIG 27 —Clinical diagnosis Ulcer of the cap Röntgenologic diagnosis Functional derangement of gastric digestion, no organic lesion of stomach or cap Surgical findings Normal stomach and cap Case XXVI

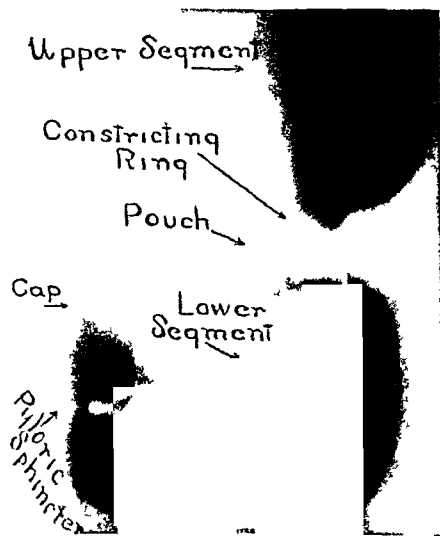


FIG 28 —Clinical diagnosis Gastric lesion of three months' duration Röntgenologic diagnosis Hour-glass stomach Surgical findings Hour-glass stomach Case XXVII

RÖNTGEN DIAGNOSIS OF LESIONS OF STOMACH

pyloruswards The wealth of detail obtained when the bismuth is suspended in buttermilk enables one to differentiate many non-malignant lesions from indurated gastric ulcer or carcinoma Theoretically the method of interpreting rontgenographic findings is much the same as that employed by the pathologist in making a diagnosis from a pathologic specimen All of the evidence assembled is utilized in making deductions, no single phenomenon being accepted as conclusive proof of a condition

The interpretation of the rontgenograms and the diagnosis of the 27 consecutive cases described in this communication are the result of a study of about 20,000 rontgenograms of 700 cases The 27 cases reported herein include all cases examined rontgenographically by Dr Cole and subsequently operated upon by Dr. Brewer Each case was referred to Dr Cole with the simple statement that an organic lesion of the stomach or duodenum was suspected; no history or data obtained by physical examination or gastric analysis being furnished As a result of the rontgenographic examination, a typewritten report was returned, giving the exact findings and an opinion regarding the presence or absence of a gastric or duodenal lesion, its location, extent and probable cause In several cases a lesion of some other portion of the gastrointestinal tract was diagnosticated Later each case was explored, and the findings at operation were recorded

The rontgenologic report on the first three cases will be given in full to indicate the method employed and the reasons for the final diagnosis In the other cases only the final conclusions will be quoted The full reports are on file in Dr Cole's library and in the hospital records

CASE I—*Clinical History*—C H P, man, chronic dyspepsia for ten years Began with pain after meals, belching of gas and occasional sour eructations Always worse after severe nervous strain Some relief from medical treatment Present condition well nourished, active man Complains of pain of a heavy, burning character one to three hours after meals Often relieved by food or vomiting History of occasional attacks of pain in right iliac fossa Gastric analysis showed marked hyperacidity

Röntgenographic Findings—Three rontgenograms of the gall-bladder region show the ribs, spine, transverse processes and kidney distinctly. There is no evidence of any shadow which could possibly be interpreted as a gall-stone, but one is not justified in making a negative diagnosis of this condition solely from the rontgenographic findings

A series of rontgenograms of the stomach, made with the patient in both the prone and erect postures, and in the anterior and posterior directions, shows its size, shape and position distinctly

Type Text-book

Size Dilated

Position Slightly prolapsed

Peristalsis 3 cycle type, equal on the greater and lesser curvatures, and unobstructed, except possibly at the extreme pyloric end of the stomach

Systole and diastole Shown distinctly

Jejunum Shown distinctly

Duodenum (descending and horizontal portions) Shown distinctly

Cap (first portion of the duodenum) Contracted in all the rontgenograms, and fails to have the clear-cut, well-defined edges of a normal cap

Pyloric sphincter Distorted by the contraction of the cap, especially on its duodenal surface

The extreme pyloric end of the stomach on the lesser curvature presents a cup-shaped depression, which may be due either to a slight involvement by adhesions, or to a pressure from without

A plate made 6 hours after the ingestion of bismuth, and after the patient had eaten a chop, baked potato and bread, shows considerable retention of food in the stomach. The outer side of the cap shows more distinctly than the inner, indicating that the lesion is on the left side of the cap

Rontgenologic Diagnosis—From a study of these plates, I believe we are justified in making a negative diagnosis of new growth of the stomach. There is, however, a definite lesion involving the cap. This does not have any of the rontgenographic evidence of malignancy, and I believe that it is due to a cicatricial contraction either from a duodenal ulcer or from gall-bladder infection. The weight of the evidence is strongly in favor of a duodenal ulcer on the lesser curvature side of the cap. Considering the definite lesion of the cap, and the moderate dilatation of the stomach and the retention of food after six hours, I believe that surgical procedure is indicated regardless of the symptoms.

Surgical Findings—The stomach was normal. In the duodenal wall, one-half inch from the pylorus, was an oval indurated nodule, about 2 cm. in diameter.

A posterior gastro-enterostomy was performed.

A chronically thickened appendix was also removed through a second incision.

CASE II—Clinical History—O. H., man, thirty-two years old. Chronic indigestion for seven years. Pain, sense of weight, nausea, and sour eructations after meals, often relieved by vomiting. Would often induce vomiting to relieve pain. Has lost flesh and strength through lack of food. No relief from eating. In hospital complained of severe pain after solid food. Gastric analysis showed hyperacidity. Wassermann test 4 plus.

Rontgenographic Findings—Rontgenograms focussed over the gall-bladder region show no evidence of any shadow which could possibly be

RÖNTGEN DIAGNOSIS OF LESIONS OF STOMACH

interpreted as a gall-stone, but one is not justified in making a negative diagnosis of such a condition solely from the rontgenographic findings

A series of rontgenograms of the stomach, made immediately after, and two, seven and one-half, and twenty-three hours after the ingestion of bismuth, shows the size, shape and position of the stomach, and the progress of the food through the tract

Type of stomach Deformed

Size Normal

Position Normal

Peristalsis 3 cycle type, obstructed on both greater and lesser curvatures in region of pars pylorica

Systole and diastole Shown distinctly

Jejunum Shown distinctly

Duodenum (descending and horizontal) Shown distinctly

Cap (first portion of duodenum) Contracted on left side

The entire pars pylorica, and part of the pars media fail to expand and contract in a normal manner Although the food begins to pass out of the stomach at an early stage after ingestion, there is considerable gastric retention seven and one-half hours later In these rontgenograms the head of the bismuth column is at the hepatic flexure The terminal portion of the ileum is considerably dilated

Rontgenologic Diagnosis—The findings indicate the presence of a primary gastric ulcer, the crater of which lies about 3 inches from the pyloric sphincter. Extensive induration surrounds the ulcer and extends along the greater and lesser curvatures of the pars pylorica, which shows annular constriction Two torsive folds extend up along the gastric wall The cap also is involved in adhesions Whether or not any of the induration surrounding the ulcer has begun to undergo carcinomatous changes as yet, can be determined only by microscopic examination after its removal

Surgical Findings—A massive induration occupied the pyloric extremity of the stomach and extended from the lesser to the greater curvature, chiefly on the posterior surface This was adherent to the transverse mesocolon, which was so infiltrated as to preclude the possibility of a posterior gastro-enterostomy A number of enlarged lymph-nodes were present along the greater curvature, two of which were removed for microscopic examination

An anterior gastro-enterostomy was done by the suture method.

Pathologist's Report—The enlarged lymph-nodes showed no malignancy, only inflammatory hyperplasia

Diagnosis Chronic ulcer of the stomach with extensive gummatous infiltration

CASE III—Clinical History—W H, man, age thirty-nine Three months before admission began to have food distress with sharp pain radiating to left side of chest, sour eructations and constant hunger Food often relieves the pain There is no loss

of weight or strength. Physical examination revealed movable tumor in epigastrium

Gastric analysis No free HCl or lactic acid Trace of blood
Hæmoglobin, 59 per cent

Rontgenographic Findings—A series of rontgenograms of the stomach, made immediately and three hours after the ingestion of bismuth, shows the size, shape and position of the stomach distinctly

Type Deformed

Size Normal

Position Normal

Peristalsis 2 cycle type Obscured along the entire lesser curvature.

Jejunum Shown distinctly

Duodenum (second and third portions) Shown distinctly, is symmetrical, corresponding in contour with the pyloric end of the stomach, separated from the pars pylorica by a space of about $\frac{1}{8}$ inch, indicating the pyloric sphincter, both surfaces of which are clear-cut, and the lumen of which is centrally located

There is no evidence of peristalsis on the lesser curvature, and its contour from the cardia to within $1\frac{1}{2}$ inches of the pylorus is absolutely constant in all the rontgenograms The involvement extends down along both the anterior and posterior walls of the stomach

Rontgenologic Diagnosis—The rontgenologic evidence in this case indicates an extensive new growth involving the entire lesser curvature in much the same manner as a saddle-shaped ulcer Considering its great extent, and the constant nodular indentations, presenting the finger-print appearance, I believe we are justified in making a diagnosis of carcinoma too extensive for reasonable hope of removal

Surgical Findings—An extensive saddle-shaped carcinoma involved most of the lesser curvature, and extended downward on both anterior and posterior surfaces There was no definite induration at the pyloric ring

A partial gastrectomy was performed

CASE IV—*Clinical History*—O V, woman, age thirty-three Early history of appendix infection followed by appendectomy seven years ago Complains of epigastric pain four hours after meals Sour eructations and frequent vomiting of sour material with relief of pain Has lost weight and strength No jaundice Physical examination negative, except for epigastric tenderness

Gastric analysis Free HCl, 30 Total, 60 Blood present in small amount

Rontgenographic Diagnosis—There is no evidence of new growth, indurated ulcer or adhesions involving the stomach or cap, and therefore no rontgenologic indication for surgical procedure on the stomach or duodenum

RÖNTGEN DIAGNOSIS OF LESIONS OF STOMACH

Surgical Findings—The stomach and duodenum were normal

A chronically thickened and adherent gall-bladder was found, containing two large stones

A cholecystectomy was performed

CASE V—*Clinical History*—Mrs H.; age forty Patient has a history of having had several acute attacks of abdominal pain and fever, followed by soreness in the lower abdomen. One of these attacks had been diagnosticated as acute appendicitis by a competent physician, who advised operation in the interval Subsequently she had suffered from digestive distress with more or less epigastric pain, gas, and sour eructations after meals These symptoms would occur at variable intervals, last two or three weeks, and then disappear On examination there was tenderness over the right hypochondriac and epigastric regions Also tenderness at McBurney's point

Röntgenologic Diagnosis—There is no evidence of adhesions or new growth involving the stomach or cap The first bismuth which passed out of the stomach proceeded rapidly through the jejunum and upper part of the ileum into the ascending and transverse colon The food then ceased to pass through the second and third portions of the duodenum, although a large amount of bismuth still remained in the stomach and cap The fact that the pylorus was open indicates that there was no obstruction to account for this retention at the pyloric sphincter

Surgical Findings—The stomach, duodenum, and gall-bladder were normal A chronically diseased appendix was removed through a second incision

CASE VI—*Clinical History*—Mrs B, age forty-four Appendix removed several years ago For past two years patient has complained of more or less constant epigastric distress after meals, with occasional vomiting of sour material At frequent intervals this distress would become accentuated, and associated with severe pain over the region of the gall-bladder While the symptoms were rather indefinite, the patient had lost much weight and strength and found it difficult or impossible to attend to her household duties Physical examination revealed a generalized tenderness over the entire epigastric region, and well-marked Murphy's sign

Röntgenologic Diagnosis—The roentgenographic examination revealed only a slight distortion of the cap, probably due to an adhesion of the gall-bladder

Surgical Findings—There was a small band of inflammatory adhesion at the summit of the gall-bladder and adjacent liver border, extending to the junction of the first and second portions of the duodenum This was divided

CASE VII—*Clinical History*—E S, woman For the past

seven months this patient had suffered from a progressively increasing epigastric distress after eating, belching of gas, and of late, frequent vomiting. Record of physical examination, gastric analysis, and blood test have been lost.

Rontgenologic Diagnosis—The extreme pyloric end of the stomach is constricted by an annular growth, more extensive on the lesser curvature than on the greater, and more extensive anteriorly than posteriorly. The weight of the evidence is in favor of the growth's being malignant. Immediate surgical procedure is indicated.

Surgical Findings—A fairly extensive carcinomatous induration was found, involving the pylorus and extending along the lesser curvature half way to the œsophageal junction.

A partial gastrectomy was performed.

CASE VIII—*Clinical History*—N H, man. Seven years ago began to experience pain after eating, located in epigastrium, often relieved by food. Symptoms would occur in periods varying from 4 to 6 weeks at a time, followed by more or less complete relief for a longer or shorter period. Ever since onset of symptoms has had more or less dyspepsia with acid eructations. Occasional attacks of pain and discomfort over appendicular region without reference to the taking of food. At present, pain more pronounced three or four hours after mid-day meal.

Rontgenologic Diagnosis—There is no evidence of new growth or indurated gastric ulcer. The irregular shape of the cap, the hazy edges of the sphincter, the lack of normal expansion and contraction of the pyloric end of the stomach, together with the appearance of the peristaltic contractions and the abnormal rugæ in this region, indicate that there is some lesion involving this portion of the stomach, probably adhesions, either from gall-bladder infection or from an ulcer. No evidence of an indurated gastric ulcer can be detected, but the constant indentation in the left side of the cap may be a duodenal ulcer. The fact that the food passed readily out of the stomach during the early stage of digestion indicates that there is no pyloric obstruction. The stasis of food in the stomach six hours after its ingestion, however, would indicate that there was an obstruction, but this stasis is probably due to some functional disturbance of the stomach or duodenum, rather than to an organic obstruction of the pylorus.

Excerpt from Dr. Cole's letter to Dr. Brewer—"This case of Mr. H. is typical of a group of about 20 cases, which show evidence of a definite lesion involving the pyloric end of the stomach and the cap. I have never felt that I could advocate surgical procedure in any such instances, although I am exceedingly anxious to know what pathologic condition causes these rontgenographic findings."

RÖNTGEN DIAGNOSIS OF LESIONS OF STOMACH

Surgical Findings—The stomach and duodenum were normal. No evidence of cholelithiasis or inflammation of the gall-bladder could be found. The appendix was removed. It was thickened, presented an obliterating stricture in its distal third, and was distended at the tip.

CASE IX—*Clinical History*—L. R., woman. Patient was first seen by the writer during an attack of incomplete intestinal obstruction. Prior to the occurrence of these symptoms, she had suffered from dyspeptic symptoms for a number of years, associated with occasional attacks of severe epigastric pain. Shortly before the symptoms of obstruction appeared, two series of roentgenograms of the stomach and duodenum were made.

Röntgenologic Diagnosis—The shadow in the gall-bladder region is a little too high for the normal position of the gall-bladder, but it certainly has the appearance of a rather large gall-stone. The absence of the duodenum, the contracted cap, the irregular and worm-eaten appearance of the pylorus, and the absence of the pyloric sphincter indicate a lesion in this region which calls for surgical procedure. This lesion is probably adhesions from gall-bladder infection with a calculus, but considering the irregular worm-eaten appearance of the pyloric end of the stomach, the possibility of carcinomatous degeneration cannot be eliminated.

Surgical Findings—The upper part of the jejunum was distended. On following the distended bowel downward for about one meter, a hard oval mass was found, almost completely filling the lumen. Below this mass the bowel was collapsed. On opening the bowel, the obstruction mass was found to be an enormous oval gall-stone, measuring 3 cm in its long diameter, and 2 cm in its short diameter. The presence in the upper jejunum of a gall-stone of this size could be explained only by its sloughing through the walls of the gall-bladder and duodenum, creating the lesion described in the roentgenologic report.

CASE X—*Clinical History*—F. C., woman. Entered the hospital for attacks of epigastric pain and sour vomiting. Appendix removed 18 months before admission. Since that operation has complained constantly of irritable stomach, irregular pains in epigastric, inguinal and umbilical regions, prostration, weakness, loss of flesh, and vomiting. Gastric analysis: Free HCl, 26, total acidity, 50, no lactic acid or blood.

The clinical picture was not characteristic of any definite lesion, but as the patient was practically bedridden, and constantly losing flesh, an exploratory operation was advised.

Röntgenologic Diagnosis—There is no roentgenologic evidence of gastric carcinoma or indurated ulcer. The incomplete filling of the cap in the majority of the plates would make one extremely

seven months this patient had suffered from a progressively increasing epigastric distress after eating, belching of gas, and of late, frequent vomiting. Record of physical examination, gastric analysis, and blood test have been lost.

Rontgenologic Diagnosis—The extreme pyloric end of the stomach is constricted by an annular growth, more extensive on the lesser curvature than on the greater, and more extensive anteriorly than posteriorly. The weight of the evidence is in favor of the growth's being malignant. Immediate surgical procedure is indicated.

Surgical Findings—A fairly extensive carcinomatous induration was found, involving the pylorus and extending along the lesser curvature half way to the œsophageal junction.

A partial gastrectomy was performed.

CASE VIII—*Clinical History*—N H, man. Seven years ago began to experience pain after eating, located in epigastrium, often relieved by food. Symptoms would occur in periods varying from 4 to 6 weeks at a time, followed by more or less complete relief for a longer or shorter period. Ever since onset of symptoms has had more or less dyspepsia with acid eructations. Occasional attacks of pain and discomfort over appendicular region without reference to the taking of food. At present, pain more pronounced three or four hours after mid-day meal.

Rontgenologic Diagnosis—There is no evidence of new growth or indurated gastric ulcer. The irregular shape of the cap, the hazy edges of the sphincter, the lack of normal expansion and contraction of the pyloric end of the stomach, together with the appearance of the peristaltic contractions and the abnormal rugæ in this region, indicate that there is some lesion involving this portion of the stomach, probably adhesions, either from gall-bladder infection or from an ulcer. No evidence of an indurated gastric ulcer can be detected, but the constant indentation in the left side of the cap may be a duodenal ulcer. The fact that the food passed readily out of the stomach during the early stage of digestion indicates that there is no pyloric obstruction. The stasis of food in the stomach six hours after its ingestion, however, would indicate that there was an obstruction, but this stasis is probably due to some functional disturbance of the stomach or duodenum, rather than to an organic obstruction of the pylorus.

Excerpt from Dr Cole's letter to Dr Brewer "This case of Mr H is typical of a group of about 20 cases, which show evidence of a definite lesion involving the pyloric end of the stomach and the cap. I have never felt that I could advocate surgical procedure in any such instances, although I am exceedingly anxious to know what pathologic condition causes these rontgenographic findings."

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Surgical Findings—The stomach and duodenum were normal. No evidence of cholelithiasis or inflammation of the gall-bladder could be found. The appendix was removed. It was thickened, presented an obliterating stricture in its distal third, and was distended at the tip.

CASE IX—*Clinical History*—L. R., woman. Patient was first seen by the writer during an attack of incomplete intestinal obstruction. Prior to the occurrence of these symptoms, she had suffered from dyspeptic symptoms for a number of years, associated with occasional attacks of severe epigastric pain. Shortly before the symptoms of obstruction appeared, two series of roentgenograms of the stomach and duodenum were made.

Röntgenologic Diagnosis—The shadow in the gall-bladder region is a little too high for the normal position of the gall-bladder, but it certainly has the appearance of a rather large gall-stone. The absence of the duodenum, the contracted cap, the irregular and worm-eaten appearance of the pylorus, and the absence of the pyloric sphincter indicate a lesion in this region which calls for surgical procedure. This lesion is probably adhesions from gall-bladder infection with a calculus, but considering the irregular worm-eaten appearance of the pyloric end of the stomach, the possibility of carcinomatous degeneration cannot be eliminated.

Surgical Findings—The upper part of the jejunum was distended. On following the distended bowel downward for about one meter, a hard oval mass was found, almost completely filling the lumen. Below this mass the bowel was collapsed. On opening the bowel, the obstruction mass was found to be an enormous oval gall-stone, measuring 3 cm. in its long diameter, and 2 cm. in its short diameter. The presence in the upper jejunum of a gall-stone of this size could be explained only by its sloughing through the walls of the gall-bladder and duodenum, creating the lesion described in the roentgenologic report.

CASE X—*Clinical History*—F. C., woman. Entered the hospital for attacks of epigastric pain and sour vomiting. Appendix removed 18 months before admission. Since that operation has complained constantly of irritable stomach, irregular pains in epigastric, inguinal and umbilical regions, prostration, weakness, loss of flesh, and vomiting. Gastric analysis: Free HCl, 26, total acidity, 50, no lactic acid or blood.

The clinical picture was not characteristic of any definite lesion, but as the patient was practically bedridden, and constantly losing flesh, an exploratory operation was advised.

Röntgenologic Diagnosis—There is no roentgenologic evidence of gastric carcinoma or indurated ulcer. The incomplete filling of the cap in the majority of the plates would make one extremely

suspicious of a duodenal ulcer, but as a practically normal cap presents in one or two of the rontgenograms, its constriction in the majority of the plates must be due to a spasmodic contraction, probably associated with a pylorospasm. There is a slight possibility that this pylorospasm is caused by a small duodenal ulcer on the lesser curvature of the cap, but there is not sufficient evidence to justify one in coming to such a conclusion.

Surgical Findings—The stomach and duodenum as well as the gall-bladder, pancreas and colon were normal.

CASE XI—*Clinical History*—J. McG., man. Three years ago began to have epigastric pain after meals, generally relieved by food and occasionally by belching. Freedom from symptoms for periods of variable duration. Occasional attacks of sudden weakness with marked pallor. Did not notice color of stools. All symptoms relieved when on a purely milk diet, but would return on resuming solid food. Gastric analysis. Free HCl, 80, total, 105; no lactic acid or blood.

Rontgenologic Diagnosis—Rontgenograms of the stomach show no evidence of new growth or indurated ulcer. The absence of the cap justifies a suspicion of some lesion involving this portion of the duodenum, possibly a duodenal ulcer. But the fact that the chyme passes rapidly out of the stomach into the second and third portions of the duodenum, jejunum, and even down into the ileum, indicates that there is little or no obstruction to the evacuation from the stomach of fluid contents. Unfortunately four- and six-hour plates, to determine how completely the stomach emptied itself, were not made.

Surgical Findings—The stomach was somewhat dilated. A moderate-sized induration was found in the first part of the duodenum, one-half inch from the pylorus. The peritoneal surface of the duodenum was puckered and scarred over the surface of the induration. A posterior gastro-enterostomy was performed.

CASE XII—*Clinical History*—T. M., man. Suffered for two years from pain two or three hours after meals, relieved by vomiting or taking more food. Often induces vomiting to relieve pain. Of late has had copious vomiting once every three or four days. No blood in vomitus. Stools often black in color. Loss of forty pounds in weight. Gastric analysis. Free HCl, 40, total, 60, no lactic acid or blood.

Rontgenologic Diagnosis—There is an obstruction of the cap, causing an immense dilatation of the stomach. This is caused by an ulcer on the anterior surface of the cap. Surrounding adhesions involve the pyloric sphincter, and possibly also extend on to the stomach.

Surgical Findings—There was a dense indurated area in the

first part of the duodenum, extending for a short distance along the lesser curvature .

A gastro-enterostomy was performed

CASE XIII—*Clinical History*—P. O'B , man For 5 years patient has suffered from a gnawing pain in the epigastrium, coming on 2 or 3 hours after eating, and continuing until relieved by next meal There are frequent eructations of gas during period of pain, and occasionally a small amount of sour irritating fluid rises in the throat Stools often black in color Has vomited only twice No blood seen in vomitus Has not lost weight or strength

Röntgenologic Diagnosis—A definite lesion involves the extreme pyloric end of the lesser curvature of the stomach, causing an anterior retraction of the cap This corresponds with an ulcer of the cap, but röntgenographic findings indicate that most of the induration involves the stomach, rather than the cap, although the lesion may have started in the postpyloric surface of the sphincter There is no evidence of obstruction The bismuth filled crater and the everted edges of the ulcer, viewed in profile, are classical Whether or not there are any carcinomatous changes at the base of this ulcer, can be determined only by a microscopic examination

Surgical Findings—A duodenal induration was found near the pylorus, with slight thickening along the lesser curvature for a distance of $\frac{3}{4}$ inch

A gastro-enterostomy was performed

CASE XIV—*Clinical History*—Since first child was born 22 months ago, patient has suffered almost constantly with dull epigastric pain, which has no relation to eating Pain radiates over whole abdomen, but is marked in upper right quadrant, and frequently passes through to back and up to shoulder Causes vomiting when severe Vomitus bitter, with dark red streaks like blood on two or three occasions. Bowels constipated Stools very dark No urinary symptoms Has never been jaundiced Has lost about 40 pounds in 3 years

Röntgenologic Diagnosis—The röntgenographic findings justify a negative diagnosis of new growth of the stomach, except possibly at a minute area near the pylorus The incomplete filling of the cap, the abnormal pyloric sphincter, and the constant indentation on the lesser curvature of the extreme pyloric end of the stomach, are the most important röntgenographic findings, and indicate some lesion at this point Considering the incompleteness of examination, one is not justified in stating with certainty whether there is an ulcer of the cap or adhesions from some other cause

Surgical Findings—The stomach, duodenum, and gall-bladder were normal A chronic appendix was removed

CASE XV—*Clinical History*—J A ; man About 6 months

ago developed dull, "grinding" pain in epigastrium about 1 hour after meals, lasting from 10 to 20 minutes, never very severe. Does not radiate up or down, is relieved by medication, belching or taking food, and has never caused vomiting. Symptoms disappear on rigid dieting, but return when regular diet is resumed. Stools not tarry in color, bowels regular, no urinary disturbance.

Röntgenologic Diagnosis—The röntgenographic findings present no evidence of gastric carcinoma. The increased width of the pyloric sphincter on the lesser curvature side of the lumen, and the irregularity of the extreme pyloric end of the stomach and the left side of the cap, indicate that there is a minute lesion involving the cap, sphincter, and the extreme pyloric end of the stomach. The entire involvement, including induration and adhesions, is less than half an inch in diameter, and causes absolutely no interference with the evacuation of the stomach. In fact, it probably acts as an irritant, causing the stomach to evacuate itself with more than normal rapidity. This is by far the smallest lesion that I have been able to recognize by this method of examination. It corresponds with Codman's pathologic description of a healed ulcer, or my own conception of an extremely early ulcer.

Surgical Findings—A small, shot-like induration was discovered on the duodenal side of the pylorus. The stomach was normal.

A gastro-enterostomy was performed.

CASE XVI—*Clinical History*—R. R., woman. For the past six months, patient has suffered from abdominal pain, chiefly located in right iliac fossa, aggravated by taking solid food. Pain increases about half an hour after meals. Some nausea. No vomiting. Is much troubled by belching of gas and sour eructations. Has lost 20 pounds.

Gastric analysis: Free HCl, 29, total, 51, no lactic acid or blood.

Röntgenologic Diagnosis—The röntgenographic findings justify a negative diagnosis of new growth or indurated ulcer of the stomach or cap. The localized collection of bismuth in a coil of the intestine, in the position of the third portion of the duodenum, is a very constant finding in all the röntgenograms. This is probably due to a kink at this point with partial obstruction, but it is difficult to conceive of such a kink in this region. There is no röntgenographic indication for surgical procedure upon the stomach or cap, but if the symptoms correspond with the localized accumulation of bismuth above described, the plates could then be used as strong corroborative evidence for operative procedure.

Surgical Findings—No lesion of stomach, duodenum or gall-bladder was found. Upper portion of jejunum was examined and found to be normal. Chronically diseased appendix was removed.

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CASE XVII—*Clinical History*.—S S, man Three years ago patient began to notice epigastric pain coming on directly after meals, lasting one to two hours, disappearing spontaneously, leaving him free until the next meal. Induced vomiting at times to relieve pain when very severe Much troubled by belching and sour eructations during period of pain Loss of 20 pounds, feels weak and miserable Gastric analysis Free HCl, 20, total, 40, no lactic acid or blood

Röntgenologic Diagnosis—There is no evidence of new growth or indurated ulcer of the stomach or duodenum The immense dilatation of a section of the small intestine in the region of the descending and horizontal duodenum indicates that there is a chronic obstruction of the small intestine, probably at the duodenojejunal junction The displacement of the first portion of transverse colon over a dome-shaped area is suggestive of tumor, possibly at the head of the pancreas The röntgenologic evidence indicates surgical procedure in region of the duodenojejunal junction

Surgical Findings—The stomach and first part of the duodenum were normal At the duodenojejunal junction was a large, hard, nodular mass behind the parietal peritoneum, surrounding the aorta, adherent to and causing pressure on the first portion of the jejunum There was also a congenital anomaly of the mesentery, resulting in a large hole or pocket, through which a considerable length of the small intestine passed without constriction Numerous other enlarged retroperitoneal nodes were found along the root of the mesentery The condition was diagnosed as probably tuberculosis of the retroperitoneal lymph-nodes The adhesions between the large glandular mass and the jejunum were separated relieving the intestinal stenosis

CASE XVIII—*Clinical History*—M C, man For past eighteen months patient has suffered with severe general abdominal pain, coming on immediately after meals, and lasting an hour or two Belches gas almost continuously Has never vomited Bowels regular, has small watery stool three times a day, usually after eating Several times has noticed blood in stool, last time three months ago Has lost about 15 pounds in 18 months Gastric analysis Free HCl, 20, total, 30, small amount of blood

Röntgenologic Diagnosis—There is no röntgenologic evidence of new growth or indurated ulcer of the stomach The constant irregularity of the cap in all the plates of the prone position, and the irregularity of the pyloric sphincter with the patient in the erect posture indicates that there is a lesion at this point But considering the symmetry of the cap in a few of the röntgenograms of the erect posture, the lesion should be regarded as spasmodic rather than organic The cause of the spasm may be

found at the appendix or at some distant point. There is no roentgenologic indication for surgical procedure at pyloric sphincter.

Surgical Findings—No lesion of the stomach or duodenum was discovered. The appendix was thickened, angulated and imbedded in adhesions.

CASE XIX—*Clinical History*—C S, man. Admitted to the hospital with a diagnosis of perforated gastric ulcer. Acute epigastric pain, severe and protracted vomiting. Vomitus contains blood. Exquisite tenderness and muscular rigidity in epigastric and right hypochondriac regions. Moderate fever. Blood count, 22,000, polynuclears, 80 per cent. As symptoms were atypical, no operation was advised, and patient was kept under observation for three or four days. At end of that period, all signs of peritoneal irritation having subsided, a series of roentgenograms was made to see if any gastric or duodenal lesion could be demonstrated.

Rontgenologic Diagnosis—There is no evidence of new growth, indurated ulcer or adhesions of the stomach or duodenum. The acute angulation in the first portion of the transverse colon, if permanent, might possibly cause the symptoms of which this patient complains. It is doubtful if the dilatation in the terminal portion of the ileum is of any pathologic significance.

Surgical Findings—The stomach, duodenum and gall-bladder were normal. There was a definite band of adhesions on the ascending colon, causing angulation. The adhesions were divided.

CASE XX—*Clinical History*—Mrs H, age sixty-seven. Indigestion since childhood. Eight years ago epigastric distress, occurring regularly 3 to 5 hours after meals, relieved by alkalines or more food. Sour eructations, gas and loss of weight. Increase of symptoms 5 years ago with hæmatemesis. In bed for several weeks. Leube cure. Gastric analysis at that time. Free HCl, 60, total, 104. Occult blood in stools. String test on 2 occasions showed stain, indicating gastric ulcer near cardia.

Rontgenologic Diagnosis—There is no roentgenologic evidence of new growth or ulcer of the stomach. Extensive adhesions, probably from an old ulcer or gall-bladder infection, involve the cap. It is evidently adherent to the liver. The stasis of food in the stomach 6 hours after ingestion corroborates this diagnosis.

Surgical Findings—The stomach was moderately dilated. In the first portion of the duodenum was a large indurated mass, $\frac{3}{4}$ inch in diameter, with extensive adhesions to the surrounding parts. A posterior gastro-enterostomy was performed.

CASE XXI—*Clinical History*—M O, man. Two and one-half years ago, having been perfectly well previously, the patient began to suffer from dull aching pain in the right lower quadrant, coming on about two hours after meals, accompanied by nausea, but no vomiting. The pain generally passes off in about half an

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hour, and is relieved by taking food. Eating meat, or any heavy food makes the pain much worse, and such articles of food have been removed from his diet for some time. Has no acid eructations. Bowels are rather constipated, though fairly regular. Has never noticed blood in movements or tarry stools. Loss of 54 pounds in last two years, though he feels fairly strong. Gastric analysis: Free HCl, 51, total, 39, no lactic acid or blood.

Röntgenologic Diagnosis—There is very strong evidence of an ulcer of the cap. The site of the ulcer is evidently about $\frac{1}{4}$ inch distant from the pyloric sphincter.

Surgical Findings—No lesion of the stomach or duodenum was discovered. A chronically diseased appendix, containing a concretion near the tip, was removed.

NOTE—Case XXI is one of the two cases in which a definite röntgenologic diagnosis was disproven by surgical procedure. The diagnosis of ulcer of the cap was based on too few röntgenograms to justify a differentiation between ulcer and spasmodic contraction. The hyperæmia and œdema, observed at operation, were undoubtedly the result of a spasm, but no ulcer was found.

CASE XXII—*Clinical History*—W. W., man. Seven years ago had distress in the stomach after eating, and vomited frequently. Occasionally vomitus contained blood. Troubled also with acid eructations. Symptoms continued for four years. Since that time has had a vague soreness over the upper abdomen with gas and occasional vomiting.

Röntgenologic Diagnosis—An annular lesion involves the extreme pyloric end of the lesser curvature. The growth lacks the characteristic indentations of the "finger-print" appearance of a carcinoma, but it should be considered malignant until proven otherwise by microscopic examination.

Surgical Findings—No lesion of the stomach, duodenum or gall-bladder was found. The appendix was removed.

NOTE—Case XXII is the second of the two cases in which surgical procedure proved that the röntgenologic diagnosis was not correct. The röntgenologic findings had all of the characteristics previously described as indicating spasm, but as the area involved was accentuated by a circular constriction, the lesion was considered organic rather than spasmodic. A careful matching of the röntgenograms over each other would have prevented this mistake.

CASE XXIII—*Clinical History*—H. P., man. Syphilis twelve years ago. Heavy drinker until seven months ago. Chronic dyspepsia for years, pain after meals, sour eructations, vomiting and soreness in epigastrium. Of late loss of weight (50 pounds). Vomiting of large quantities of foul undigested food. Gastric analysis: Free HCl, 38, total, 50.

Röntgenologic Diagnosis — There is no evidence of new growth involving the stomach itself. An obstruction presents at the pylorus, involving either the first portion of the duodenum or the pyloric sphincter, or both. The lesion probably is due to a duodenal ulcer, either old or new. Considering the immense pro-nathian dilatation of the stomach, and the retention of food, there is no question but that surgical procedure is definitely indicated.

Surgical Findings — The stomach was enormously dilated. A hard indurated mass, one-half inch in diameter, extended on to first portion of duodenum. A gastro-enterostomy was performed.

CASE XXIV — *Clinical History* — M. M., woman. Indigestion since childhood after tiring work. Occasional sharp attacks of colic in upper abdomen of late. Epigastric distress, occurring after meals, about 11 A. M. and 5 P. M., and after retiring at night. Considerable loss of weight.

Röntgenologic Diagnosis — There is no evidence of carcinoma or indurated ulcer of the stomach itself. The constant deformity of the cap, viz., the permanent indentation in the upper edge and the pouching of the lower portion, indicates a definite lesion in the upper portion, either from a duodenal ulcer or gall-bladder infection, with the weight of the evidence in favor of the former.

Surgical Findings — The stomach was found to be normal. A small, shot-like induration presented on the posterior wall of the duodenum, $\frac{1}{4}$ inch from the pylorus. A gastro-enterostomy was performed.

CASE XXV — *Clinical History* — J. P., man, age forty. The patient had dysentery in 1899. Since 1905 has had chronic indigestion, hunger pains, occasional severe pain in epigastric area after eating, with more or less soreness in appendicular region.

Röntgenologic Diagnosis — No evidence of new growth or indurated ulcer of the stomach or duodenum can be detected. The contraction of the cap and the extreme pyloric end of the stomach is probably due to a spasm or possibly to adhesions. The flattening of the left side of the ascending colon, the incomplete distention of the cæcum, the insufficiency of the ileocæcal valve, with the distended coils of small intestine pressing on the left side of the ascending colon up to the region of the gall-bladder, are sufficient to cause the spasm of the stomach and cap.

Surgical Findings — The stomach and duodenum were normal. Two small adhesions passed from the summit of the gall-bladder and duodenum to the liver. An adherent, thickened and angulated appendix was removed.

CASE XXVI — *Clinical History* — N. R., woman, age twenty. Six months ago the patient first began to complain of pain in epigastrium, coming on 2 or 3 hours after meals, gnawing in

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character and relieved by taking food or bicarbonate of soda. Three months later the pain began to be associated with attacks of vomiting, which relieved the pain. Vomitus consisted of food recently taken, and twice contained a little blood. Four months after onset of symptoms, patient entered hospital and was treated for 3 weeks with a diet. *Diagnosis* Gastric ulcer. After leaving hospital, was free from pain until a week ago, when it returned with occasional vomiting. Loss of 16 pounds in last 6 months. Gastric analysis. Free HCl, 17, total, 36; no lactic acid or blood.

Röntgenologic Diagnosis—The röntgenographic findings justify a negative diagnosis of new growth or indurated ulcer of the stomach or duodenum. That there is an extreme functional derangement of the stomach is evident from the erratic motor phenomena. When the food was first administered there was a great atony, and no evidence of peristalsis. A few minutes later the peristalsis became hyperactive, and the food was rapidly expelled through a wide open pylorus for a short time, and progressed at great speed through the cap, duodenum and into the jejunum. The $2\frac{1}{2}$ -hour röntgenograms show that the stomach is perfectly normal in position, and the cap well distended. But there is no evidence of any food passing through the duodenum or jejunum. In the $5\frac{1}{4}$ röntgenograms, a moderate gastric retention is seen, with no evidence of the pars pylorica, cap, duodenum, or jejunum. I am unable to determine the cause of this functional disturbance.

Surgical Findings—The stomach, duodenum and gall-bladder were found to be normal. A thickened and congested appendix, containing a large amount of fecal matter, was removed.

CASE XXVII—Clinical History—S. B., woman. For the past 3 weeks patient has complained of almost constant epigastric pain, eructations and nausea. On the day before admission she had an attack of severe pain, radiating to the side and back. The pain has no relation to eating and is relieved by vomiting, which occurs frequently. The vomitus is usually small in amount, greenish and occasionally blood streaked. The patient has never been jaundiced. She believes she has lost some weight. Gastric analysis. Free HCl, 0, total, 26, lactic acid, 0. Blood positive. Blood analysis. Haemoglobin, 80 per cent, red blood cells, 5,000,000, white blood cells, 12,000.

Röntgenologic Diagnosis—There is evidence of an organic hour-glass constriction, with a pouching or perforated ulcer on the lesser curvature, or perhaps a double constriction. Personally, I have seen these lesions occur in unquestionable cases of carcinoma, and I am therefore not prepared to state that it is indicative of a non-malignant condition.

Surgical Findings—On operation it was discovered that the entire central area of the stomach was distorted by a massive carcinomatous induration, extending from the lesser curvature to the greater, more marked on the posterior surface, in which situation the induration also extended to the pancreas. This resulted in an hour-glass contraction of the stomach, the upper segment of which was concealed beneath the costal border. The lower pouch lay in its normal position. It was impossible to do a gastro-enterostomy with the upper pouch on account of its high position. A gastrogastrostomy was therefore made on the anterior surface of the stomach by the suture method.

In summing up the evidence furnished by this series of 27 cases, it will be seen that of the 22 cases in which a definite diagnosis was made by the Rontgen method, subsequent operation proved that in 20 instances this diagnosis was correct, and in 2 it was incorrect. In 11 of these cases the diagnosis was a negative one regarding the presence of a gastric or duodenal lesion, although the clinical history so strongly suggested ulcer or carcinoma as to justify exploratory operation. In not one of these cases was an organic lesion found to exist. In the 5 instances in which the rontgenologic diagnosis was not definitely stated, owing to incomplete observation, or unusual findings which could not be definitely interpreted, and concerning which only an opinion was expressed as to the probable lesion present, the opinion proved to be correct in 4 instances and incorrect in one instance. In other words, in this particular series, a correct diagnosis was made by serial rontgenography in 89 per cent of the cases. The information obtained from this series has been invaluable to the rontgenologist in his interpretation of unusual findings, and the experience gained from the hearty cooperation of the surgeon will greatly increase the accuracy of this method of examination.

The objections to the method are obvious. It requires considerable time and is moderately expensive. If it could be shown that a simpler method would give equally good results, that method would undoubtedly become the popular one. In the opinion of the writers, however, serial rontgenography will give more accurate information concerning lesions of the stomach and duodenum than any other method now employed.

PERSISTENT EMBRYONAL TYPE OF LARGE INTESTINE *

BY H. BEECKMAN DELATOUR, M.D.

OF BROOKLYN, NEW YORK

A KNOWLEDGE of embryology is necessary to a proper understanding of certain pathological conditions encountered during surgical operations. The possession of this knowledge before being confronted by these anomalies during an operation will be of great aid in determining the proper procedure to follow.

We have had presented to us on the operating table at various times certain anomalous positions of the intestine which, when studied, were found to be in fact persistent embryonal types. The following cases will illustrate.

CASE I —A lady in middle life was seized with severe abdominal pains in the upper abdomen, with nausea and vomiting. After a few hours the pain and tenderness were confined to the right hypochondrium. The pulse and temperature as well as the blood count indicated a rather acute inflammation. There was no tenderness in the iliac region. A diagnosis of acute cholecystitis was made and operation advised.

Operation —Right rectus incision in the upper abdomen. On opening the peritoneum there were the evidences of a local peritonitis, the intestine being covered with fresh lymph. On separating the recent adhesions between the liver and intestine we came on an acutely inflamed and gangrenous appendix. The appendix lay between the cæcum, situated at the site for the hepatic flexure and the liver, and passed upward, inward, and backward, being attached to the gall-bladder. The appendix was removed in the usual manner. The ileum joined the cæcum from below.

This is one of the more common forms of the embryonal type, as it is the last stage in the process of elongation and rotation of the large intestine. This is the position the cæcum should occupy about the fourth month of intra-uterine life. Smith, in his review of the position of the cæcum in infants, states that in 1050 autopsies on infants under three months he found the cæcum in this position 63 times.

In numerous cases of appendicitis in children we have found the appendix situated above the level of the umbilicus. This proves that in

* Read before the New York Surgical Society, October 28, 1914.

many the complete descent of the cæcum does not take place until after birth While we cannot give accurate figures we have seen the cæcum and appendix in this position in a sufficiently large proportion of cases for us now to always place the incision in children at a higher level than in adults

Nine examples of undescended cæcum in adults have come under our observation

CASE II—H W B, salesman, fifty years Nothing in the early history bearing on the present condition There was no history of stomach or intestinal disturbance

Thirty hours before admission to the hospital, he was suddenly awakened with extreme abdominal pain, localized in the epigastrium and left hypochondriac region There was no nausea, but the patient produced vomiting in the hope of getting relief He was given some anodyne and heat applied There was tenderness above and to the left of the umbilicus That evening his condition seemed somewhat improved, and the tenderness less marked In the morning there was more marked distention, and pain had increased He was at once removed to the hospital At the time of admission the pain had become general, and the tenderness most marked to the left of the umbilicus There was considerable distention Diagnosis Probable duodenal or gastric ulcer

Operation—Forty hours after beginning of attack, an incision, four inches long, was made to the left of the median line with its lower end opposite the umbilicus On opening the peritoneum there was an escape of purulent serum and the distended intestines were much injected In the region of the stomach and duodenum, there was no evidence of lesion and the fluid came up from below The incision was then extended downward and the ascending colon found to be to the left of the median line On following this downward, we came to some recent adhesions between the cæcum and the descending colon On breaking through these there was a discharge of foul-smelling pus and in the cavity formed between these portions of the bowel was found a completely gangrenous appendix The appendix lay along the left side of the spine with the tip adherent to the left kidney The appendix was ligated and removed The patient took the anæsthetic badly and it was with much difficulty that the distended intestines were handled

For twenty-four hours the progress was satisfactory, but, at the end of this time, distention began again and was accompanied by nausea, and a little later by vomiting of a greenish fluid There was also a good deal of abdominal pain Lavage gave very little

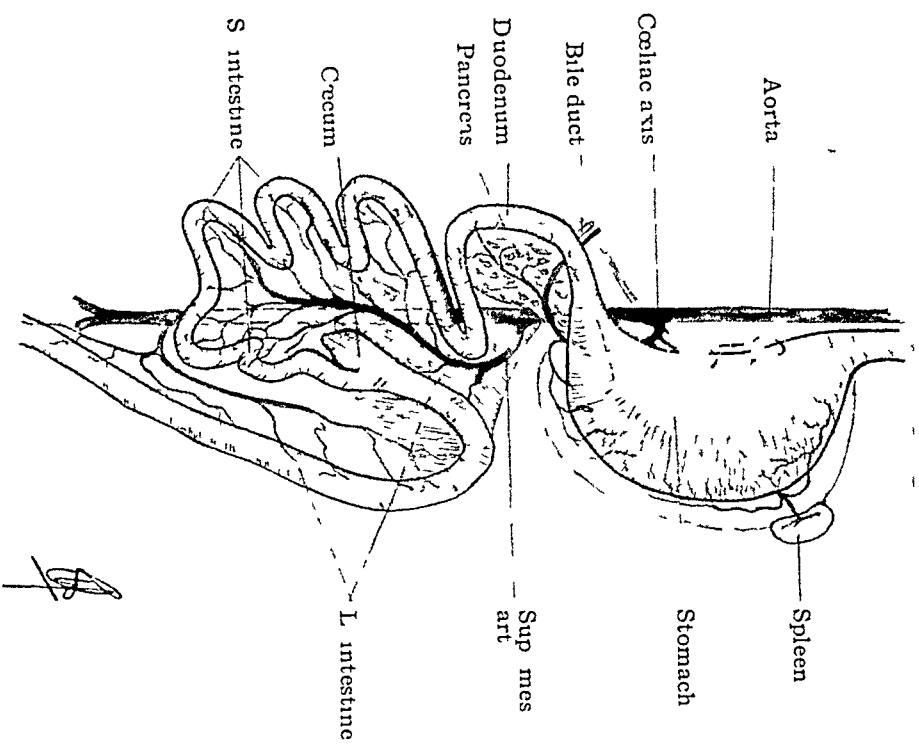


Fig 1 —Diagram representing early stage of rotation of abdominal viscera (Deaver's Surgery of the Upper Abdomen)

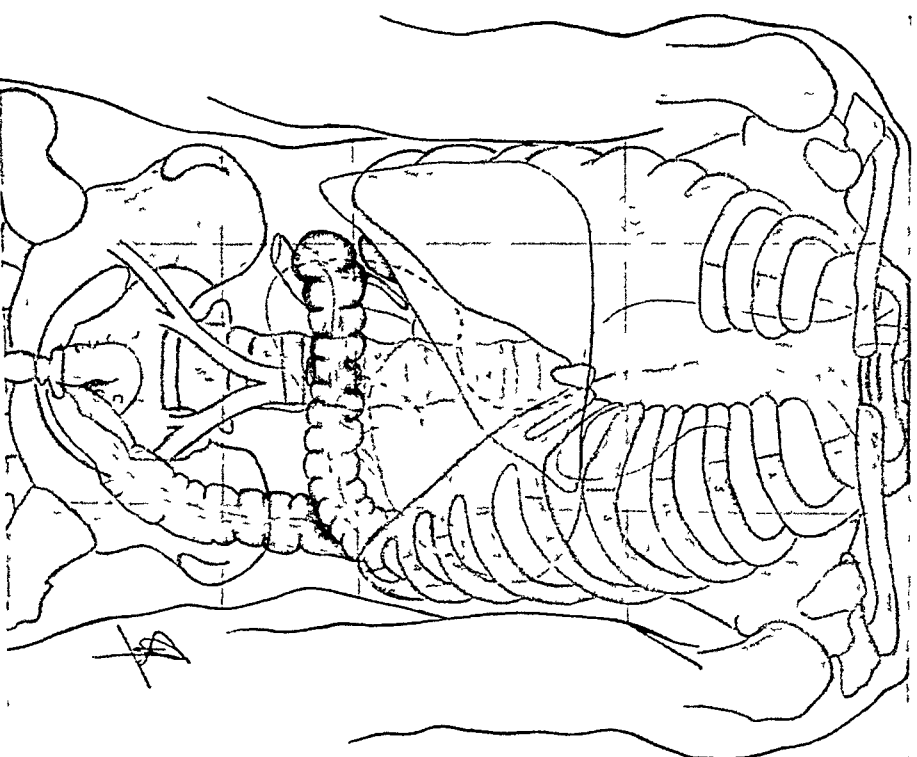


Fig 2 —Case I Partial rotation of large intestine

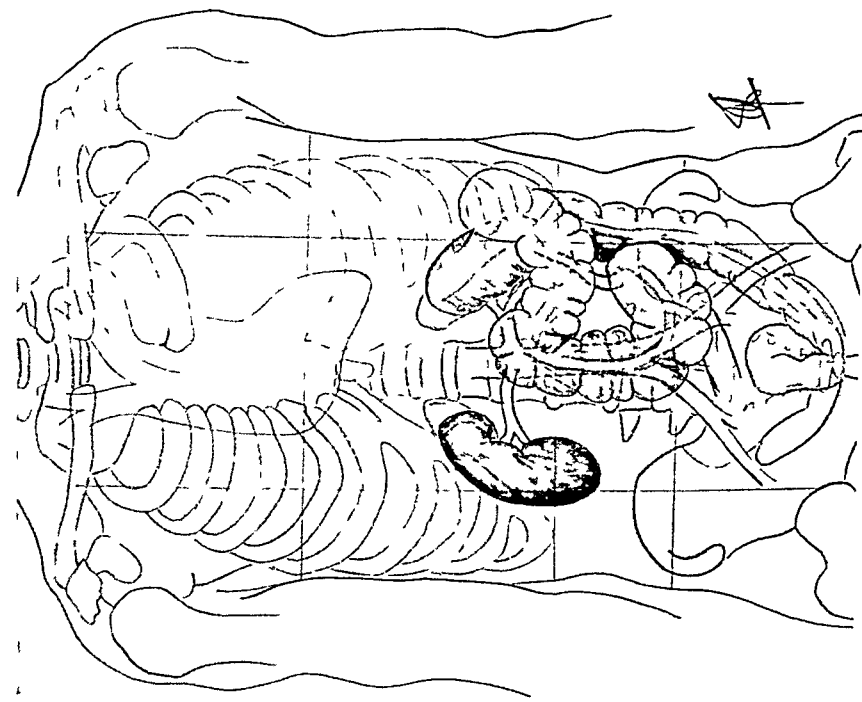


FIG 3 -- Case II Appendix to the left of median line the colon nearly in the median line

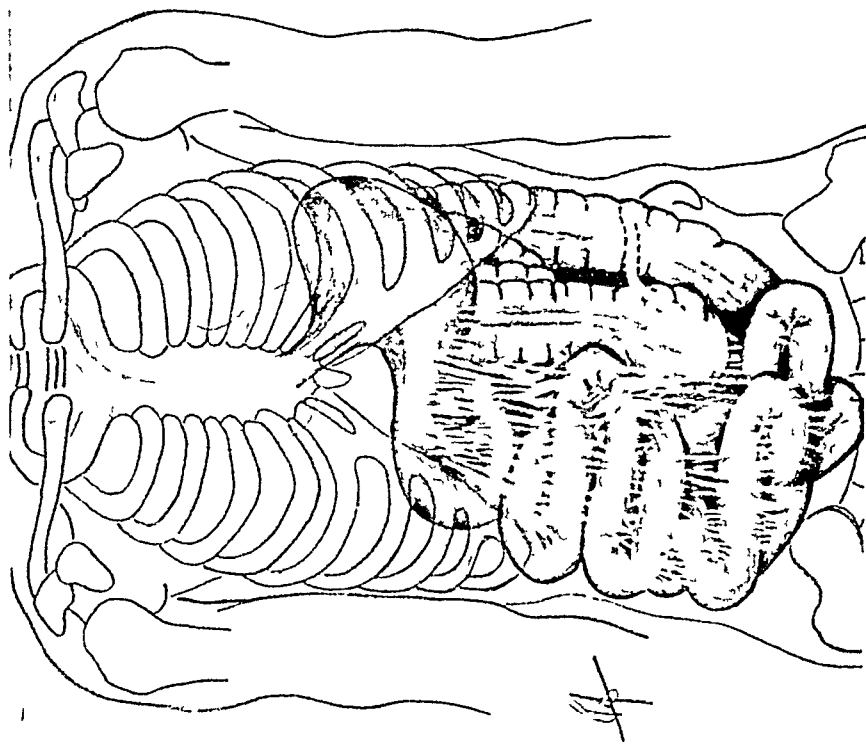


FIG 4 -- Case III Entire large intestine to the left of median line The appendix in left iliac fossa and the uncovered small intestine to the right

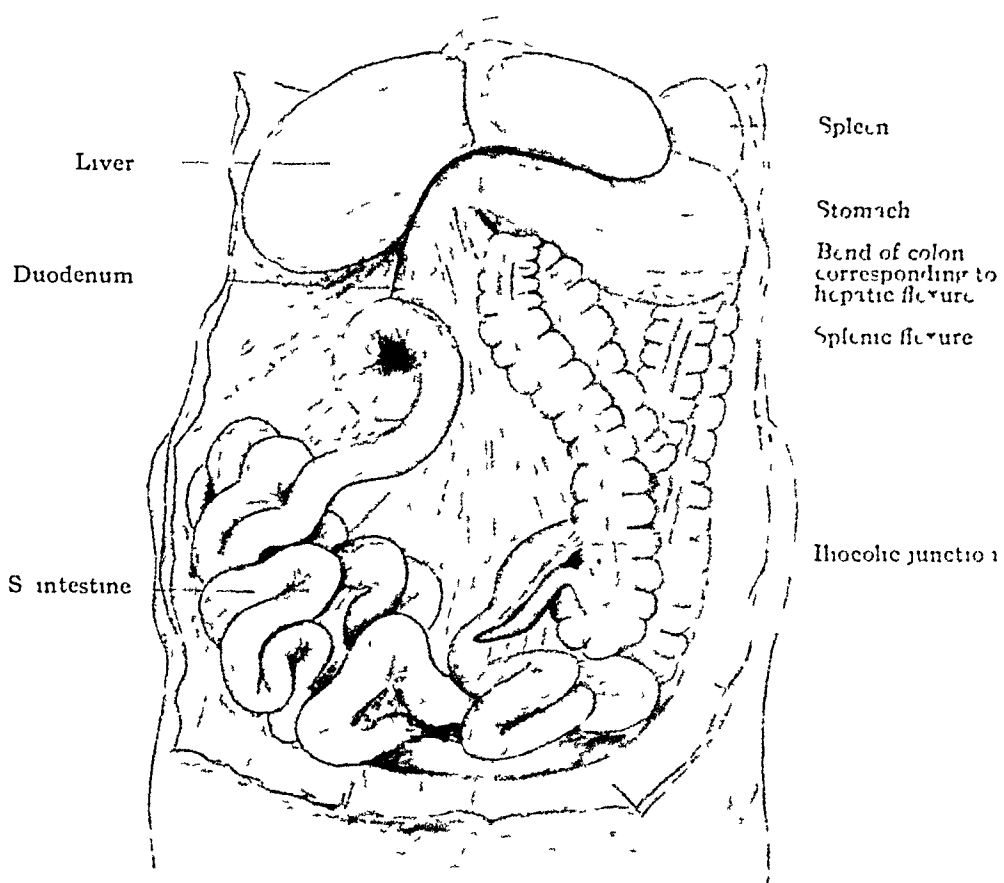


FIG 5 —Abdominal viscera of adult human male, non-rotation of intestine (Columbia University Museum —Huntington's *Anatomy of the Peritoneum*)

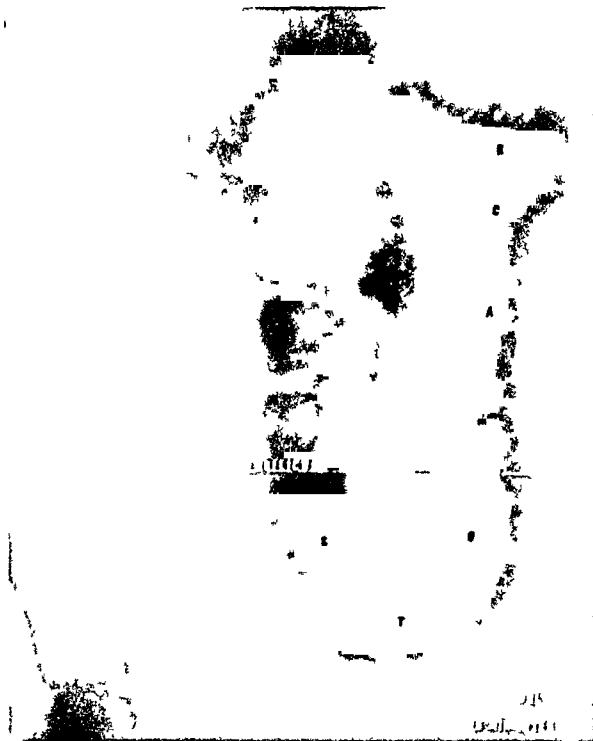


FIG 6—Case III Five minutes after bismuth meal The stomach does not begin to empty in a normal manner, the appearance is that of pylorospasm (Röntgenogram by Dr L T Le Wald at St Luke's Hospital New York)



FIG 7—Case III Thirty-three minutes after bismuth meal Only enough of the meal has gone through the pylorus to outline the duodenal cap This confirms the diagnosis of pylorospasm (Röntgenogram by Dr L T Le Wald)



FIG 8—Case III Two hours and fifty minutes after bismuth meal The spasm has now relaxed and a large portion of the meal has been rapidly passed through the pylorus Note the peculiar position of the duodenum, it passes almost straight out to the right and then curves downward, it is characteristic of the appearance of non-rotation of the colon (Röntgenogram by Dr L T Le Wald)



FIG 9—Case III Eight minutes after bismuth injection and about three hours after administration of bismuth meal Note that the entire colon is practically to the left of the median line showing the typical appearance of complete non-rotation of the colon The jejunum and ileum appear to be almost all to the right of the median line Note the position of the duodenum passing to the right instead of downward and behind the stomach (Röntgenogram by Dr L T Le Wald)

PERSISTENT EMBRYONAL TYPE OF LARGE INTESTINE

relief Enema brought away considerable gas, and some faeces There was considerable purulent, offensive drainage from the wound The patient's condition gradually became worse, with all the evidences of a general septic peritonitis, and he died on the third day

In this case there was a short transverse colon, with the ascending colon passing obliquely downward across the abdomen to the left, the cæcum being entirely to the left of the spine This case and the following are examples of the position of the large bowel in the earlier months of fetal life

CASE III —F H F, 19 years Until fourteen years of age was never a strong boy Although generally constipated, he suffered at times prolonged attacks of diarrhoea He always had more or less vague abdominal pains Ten days before admission to the hospital, he suffered an attack of diarrhoea, with severe abdominal pains about the umbilicus Two days ago the pains again became severe On the day of admission the pains remained quite severe, there was fever, and tenderness immediately below the umbilicus, with marked rigidity of the left rectus Blood examination, leucocytes, 11,400, polymorphonuclears, 70 per cent A diagnosis of appendicitis, with appendix to the left, was made

Operation—An incision through the right rectus muscle was made, nearer the median line than usual On opening the peritoneum, the first thing of note was the peculiar appearance of the small intestine and stomach, and the non-appearance of the large intestine The right abdomen contained a mass of coils of small intestine, bound together by thin membrane, in places angulating the gut and in others producing a narrowing of the canal, almost to occlusion In the upper angle of the wound could be seen the stomach with the duodenum, supplied with a mesentery, coming from it in almost a straight line The usual curve at the pylorus was absent No colon or omentum was to be seen. The hand was then passed to the left side of the abdomen and the cæcum found to be in the left iliac fossa, with ascending colon passing directly up and parallel to the descending colon The cæcum was lifted up and with it the inflamed and thickened appendix. The appendix lay in the left iliac fossa The appendix was removed.

Attention was next directed to the small intestine and many inches of the bands of adhesion, or veils, were divided in order that the bowel might be relieved of constrictions The wound was then closed in layers without drainage

The first forty-eight hours following operation presented nothing unusual, except for some hiccough. The patient was exceedingly anxious and apparently apprehensive. On the third day there was marked vomiting and considerable abdominal pain. The patient at times appeared to be irrational. The temperature on June 13, the second day after the operation, was 98° F, and the pulse 54. From then until June 19, the eighth day, the progress was very satisfactory. On the evening of this day trouble began with pain and vomiting of a quantity of undigested food. During the next four days vomiting became almost persistent and lavage gave only temporary relief. The patient was retaining no nourishment, the temperature became subnormal, the pulse rapid and feeble and the eyes sunken. There was complaint of griping pains, burning in the stomach, and constant hiccough and coughing. The bowels moved regularly and there never had been any distention. No reason could be discovered for these symptoms and as the boy was exceedingly neurotic, most of the symptoms were attributed to this. The boy, however, was losing ground.

The vomit was very acid and irritated the skin about the mouth, the urine was exceedingly acid and the odor about the bed was acid. At this time Dr. Duffield, who had been kindly attending the case for me, as I left for my vacation the day following the operation, came to the conclusion that the trouble might be one of the acidoses, and began the administration of milk of magnesia in two-drachm doses, every two hours. This was also used as a mouth wash. There was immediate improvement following this and after twenty-four hours no further vomiting. Improvement was rapid and at the end of the week he was able to be removed to a hotel. The case finally went on to complete recovery.

After leaving the hospital the patient was under the care of Doctor Donald Gordon, of Manhattan, who wrote me as follows:

I saw him three weeks after operation and on examination of abdomen, immediately after the ambulance trip, I could make out easily peristaltic waves moving from left to right midway between the ensiform and umbilicus. I should say they extended over a distance six inches broad, as if made by a large viscus. They were visible to his father and the nurse. He had an indefinable sensation accompanying these, which stopped when the waves ceased, though he did not know what I was observing. The waves could be stirred up by gentle massage of the upper abdomen.

The boy went rapidly from whey to milk, eggs soft-boiled and poached, to custard in cream, etc. He seemed so hungry and craved food in the form of a square meal that I put him on a rather liberal diet more quickly than I ordinarily would in an obscure

PERSISTENT EMBRYONAL TYPE OF LARGE INTESTINE

surgical condition I gave him no medication except the milk of magnesia and an enema every other day for his bowels, which improved their action when he obtained more food. About a week after I first saw him he had a period of uneasiness one evening which grew into pain in the epigastrium. This was relieved by a hot stupe and he fell asleep. The next day he went on with the same liberal diet that he had been on. He continued good for four days, gaining rapidly in strength. He then had a second attack of abdominal pain about twelve hours after eating supper. He vomited at that time some prune skins, though nothing else from a hearty meal the night before.

The case looked to me as one where his ptosed stomach brought about a pyloric contraction due, possibly, to pulling down of the stomach, though there was no apparent distention in the stomach or intestine during the time I saw him. The magnesia seemed to relax this spasm by aiding in rendering the duodenum alkaline, which probably had not a sufficiency of alkaline secretion to neutralize the large secretion of acid gastric juice which may have been present.

Under date of August 2, the patient wrote

My condition is good. I have gained almost all my lost weight and have gained in strength so that I can walk a few miles and play tennis. My intestines seem to be assuming a normal state.

In a paper entitled "Unusual Cæca in 130 Autopsies," Byron Robinson states that in two there was complete and in ten partial non-descent of the cæcum. He attributes the failure of the intestine to completely develop and rotate to intra-uterine peritonitis. There is no direct evidence, however, that this is the case.

From recent articles published it would appear that non-descent of the cæcum is not rare but that it varies greatly in extent. When the cæcum is placed as in Case I, it becomes very difficult to differentiate the condition from an inflammation of the gall-bladder or possibly a gastric ulcer.

In Cases II and III the exact diagnosis may be quite difficult and the point of opening of the abdomen becomes important. Charles Mayo reports a case in which the McBurney incision was first made, but as the appendix lay beyond the median line it became necessary to make a median incision in order to complete the operation. In this connection we would state our preference for the rectus incision in all appendiceal cases because of the ease of reaching other organs by simply enlarging the incision.

If on opening the abdomen on the right side the small intestine, un-

covered by omentum or large bowel, presents, we should at once suspect the possibility of non-rotation of the large intestine and the presence of one of the above described embryonal types of large intestine

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FIG 1 —Lateral and anteroposterior X-ray views showing area of fracture

FRACTURE OF THE TIP OF THE INTERNAL CONDYLE OF THE FEMUR

LOOSE BODY IN THE KNEE-JOINT

BY MILTON G. STURGIS, M.D
OF SEATTLE, WASH

THE unusual character of this fracture as well as the unusual picture of a foreign body presumably free in the knee-joint, for a period of six weeks, without causing discomfort, are my sole excuses for presenting the following.

The patient, a well-developed man physically, on March 20, while alighting from a slowly-moving automobile, slipped, wrenching his knee, he was not disabled but was discommoded, there was slight ecchymosis in the popliteal space, and he was slightly lame.

Because of an accident policy he consulted me on April 10, and an examination, without X-ray, showed no tenderness in the joint, no fluid, no limitation of motion, no discernible abnormality of the joint, but only an old ecchymotic area behind the knee.

He was able to keep at his work (that of carpenter) until May 1, when his knee suddenly "locked," which it did with increasing frequency until May 18, when he again consulted me. While examining him at this time, the knee suddenly "locked" with an acute spasm of the vastus internus muscle. An X-ray, taken immediately after, disclosed a shadow in the suprapatellar fossa on the inner side. Operation was advised and accepted.

On the morning following the patient objected to operation, because he said, "the fragment has slipped back into place and the knee is all right", but acceded on explanation that his trouble would recur.

On opening the joint we were unable to find the foreign body in the location shown in the X-rays. The incision was then extended and an examination of the joint disclosed the fragment as well as the area of fracture in the internal condyle. The appearance of the latter indicated that apparently there had been complete separation of the fragment at the time of the original injury. This fragment then had been loose in the articular portion of the knee-joint for about 40 days without causing any marked discomfort, which latter resulted only when it had slipped into the shallow suprapatellar fossa.

The disparity shown in the X-rays between the size of the shadow of the fractured area in the condyle, and the size of the shadow of fragment, is to be explained by the fact that only the osseous portion of the fragment cast any appreciable shadow.

JOINT MOUSE

BY LEONARD W ELY, M.D

OF SAN FRANCISCO

(From the Laboratory of Surgical Pathology, Leland Stanford Junior University)

IN spite of all that has been written on the subject of joint mice, the origin and method of formation of these bodies have never been settled definitely, and still form interesting subjects of study. A search through medical journals, especially through German journals, of the past few decades will reveal a large number of articles dealing with joint mice, and a great difference of opinion regarding them. To any one familiar with the bibliography of joint mice the case which I am about to report should prove interesting in several respects, notably as to the place of origin of the body, its structure and the history.

A joint mouse is defined usually as a loose piece of cartilage, or of bone and cartilage, in a joint, but this definition is much too broad, for it would include the fragments of bone and cartilage set free as the result of joint tuberculosis, tabetic arthropathy, arthritis of Type II,¹ etc. In point of fact, the essentials of the morbid process at the bottom of arthritis of Type II, etiologically and pathologically, are probably identical with those at the bottom of joint mice, but when we speak of a joint mouse we have in mind a condition in which the loose cartilage is the sole or the main element.

My patient was a well-nourished married man of twenty-one years of age, a teamster and a boxer. He denied syphilis and gonorrhœa, and gave a history of jumping from his wagon, six months before, in perfect health, and injuring his left knee. He had had no symptoms previously in his joint. The injury was followed immediately by pain and swelling.

The symptoms persisted and forced the patient to seek relief at the Lane Hospital.

Examination showed marked swelling of the left knee, with obliteration of the normal joint contour. The swelling was tense, and evidently was due to fluid in the joint. Motion was markedly restricted, and sensitiveness was present over the medial aspect near the joint line. A hard, movable body of about the size of the

¹ Arthritis of Type II corresponds to the arthritis deformans of the Germans, the osteo-arthritis of the English, the hypertrophic arthritis of Goldthwait, the degenerative form of Nichols and Richardson, etc.



FIG. 1 —Loose body removed from joint natural size



FIG. 2 —Showing defect in surface of condyle of femur produced by the separation of the portion of cartilage

JOINT MOUSE

end of the thumb could be felt in the lateral part of the joint, slipping about under the examining fingers

Operation (April 13, 1914) —Under ether the joint mouse was located in the lateral part of the joint, and, while I held it between my fingers, my assistant made an incision, about 6 cm in length, through the skin directly over it, and then an incision, about 3 cm. in length, through the capsule. A quantity of reddish, straw-colored fluid escaped. With a pair of toothed forceps the assistant seized the body and withdrew it. The wound was then sewed up with catgut in layers.

The subsequent course was uneventful. The patient walked with crutches on the tenth day, and left the hospital on the thirteenth day.

The joint mouse was a disc-shaped piece of glistening, normal-appearing cartilage, $27.5 \times 22.5 \times 10.5$ mm in diameter, perfectly smooth on one side, but more uneven on the other (Fig. 1). One of its borders was notched. Its uneven side was covered with what appeared to be a thin layer of fibrous tissue. The body looked as if it had come from the condyle of the femur. On section it was found to consist exclusively of cartilage.

An anteroposterior skiagram of the knee showed an area of rarefaction in the medial condyle of the femur (Fig. 2), closely corresponding to the shape of the loose body, and a lateral skiagram showed a production of bone on the anterior surface of the medial condyle, corresponding again to the size of the body, and looking as if it had taken the place of the lost cartilage.

Cross-sections were made of the cartilage, imbedded in celloidin, stained with eosin and hæmatoxylin, and by Van Gieson method, and mounted in balsam.

Microscopical Examination —This showed that the body was made up of cartilage throughout, except for a thin layer of new connective tissue on the surface towards the femur.

In the most superficial part of the superficial layer (the narrowest), the cells are arranged parallel to the surface, as in an articular cartilage. Deeper in, they are in larger groups and have lost their parallel arrangement. They are without capsule, and resemble fibroblasts rather than cartilage cells. Most of them are fusiform. They are arranged singly or in groups of two, three or more. Their nuclei stain well.

Very close to the surface one sees here and there gaps in the cartilage, filled with fibroblasts and collagen—connective tissue.

In the second zone, wider than the first, the cells are arranged in groups, and throughout each group the matrix stains rather deeply with hæmatoxylin, giving this zone a blue color perceptible to the naked eye. A few of the cells are in their capsules, as shown in the photomicrograph, but for the most part the cells are without capsule, and the cell body

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cannot be distinguished from the surrounding matrix. Some cells have lost their nuclei. The general cell arrangement is perpendicular to the surface.

In the third layer, the deepest of the three, the cells have no definite alignment, and are arranged in groups of two to ten or more. Many of them are dead, but many stain well, and show definite capsules. The diffuse blue stain seen in the second layer is not present here.

Deep in the third layer, at or very near its lower limit, are gaps or cavities of larger or smaller size containing more or less detritus and some calcified material. The walls of these cavities show for the most part a thin layer of calcification.

Below the cartilage again—that is, on the under surface of the body—is the layer of connective tissue. This consists largely of young, cellular fibrous tissue, which either borders directly upon the cartilage or is separated from it in places by a layer composed of cartilage cells in a collagen matrix, looking much like fibrocartilage. For the most part these two layers are rather sharply marked off from each other by a condensation of fibroblasts, but occasionally the boundary between the two is not well defined. Three or four giant-cells can be seen in the young fibrous tissue, looking like typical marrow megaloblasts.

We shall not build up an elaborate theory of the origin of “Gelenkmause” from this specimen, but several points are worthy of mention.

1 The body originated almost undoubtedly from the medial femoral condyle, as shown by the Rontgen picture.

2 Its former site has been filled with bone, as shown by the Rontgen picture.

3 Its comparatively smooth femoral surface covered completely with new fibrous tissue, and the absence of any bone spicules or of marrow, show that it was not broken off immediately by the injury.

4 While many of the cartilage cells are dead, distinct evidences of proliferation are present. The body is thicker than the normal femoral cartilage. This demonstrates that the cartilage could not have been killed at the time of injury, and then have been dissected off later by the marrow, as in the recent experiments of Axhausen on animals' cartilages.

KELOID FORMATION IN THE NEGRO^{*}

BY ADDISON G. BRENIZER, M.D

OF CHARLOTTE, N. C.

THOSE of us in the Southern States devoting our time to surgery and anatomy, and of a necessity having the negro among our clientele, are in a position to observe many physical and functional differences between the black and white races. One of the most interesting conditions to which the negro shows a marked susceptibility is the development of keloids.

It is a common and almost daily observation to see among our negroes those bearing scars on their necks and chests marked by an excessive tissue formation. Some of these growths are quite large and others very fantastic, taking on the most bizarre forms (Figs 1, 2 and 3). A great many give the history of a former "scrofulo" (cervical tuberculosis adenitis) where the glands have either broken down or have been excised. The growths are most common in wounds healing by granulation, but some follow a minimum injury or irritation, like the piercing of the ear-lobes (Figs 1 and 2). The neck and chest seem to be sites of predilection.

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There are, however, many facts to disprove the tuberculous and infectious origin of keloids and to place them rather under the head of tumor growths. Hallopeau speaks vaguely of the lesion, that it is "only a manifestation of a morbid tendency peculiar to the subject." He means

^{*} Read before the North Carolina State Medical Society, June 16, 1914

by this statement simply that he does not know the provoking cause of keloids any more than he knows the cause of other tumor growths, but that the keloids like these growths do not resemble any of the results of bacterial action. A keloid may develop along the whole length of a scar or only at the point of a single stitch hole, respecting many other stitch holes along the line of the incision. It must be admitted then that this alteration of the cicatrix does not depend solely upon a question of a fertile field for bacterial growth. Figs 1 and 2 picture a large keloid following a needle hole made in each ear, and there is also a keloid over the right buttock of the same patient over a burn. This case would suggest that the tendency to keloid were not local but a general disposition. Fig 3 shows a case of keloid formation in old syphilitic scars on the chest and in a scar under the lower jaw, the result of a cut. This case also suggests the tendency to keloid formation on the part of the negro, irrespective of the character of the local irritant. Keloids spring up apparently without local irritation just as other tumors do. It is always possible, however, that the growth arises in response to an irritation less than a needle prick, the causative factor in the case shown in Figs 1 and 2. Out of 20 keloids gathered by Bloodgood among 200 benign connective-tissue tumors, 6 of the keloids were spontaneous, the so-called "true keloids," and 14 occurred in scars, the so-called "cicatricial keloids."

Histologically, the keloid is a fibroma of the skin arising in the connective tissue of the derma. The epidermis is adherent over the tumor and is very thin. Occasionally in spontaneous keloids, more often in cicatricial keloids, and especially when they are recurrent, areas of spindle-cells resembling a sarcoma are found. The growth is prone to recur locally after the removal but does not metastasize. This is due to the structure, the close cohesion of cells and low vascularity, the structure of a fibroma. Cicatricial keloids rarely disappear spontaneously after several months. In most keloids no bacteria nor parasites are found and those objects taken for parasites are doubtless due to faulty fixing and staining.

Owing to the analogy of experience with so many diseases which have proven to be of bacterial origin, as with the tubercle in tuberculosis and the gumma in syphilis, the cause of keloids has often been attributed to microorganisms and parasites. Since the keloid is histologically a fibroma and histogenetic studies have established that the keloid does not grow through changing the surrounding cells into tumor cells, but grows as a mass of foreign cells from an original focus and does not (as for example, the tubercle and the gumma) involve the

FIG 1.



FIG 2



FIGS 1 and 2 —A case of keloid formation hanging from the lobe of each ear. Fig 2 shows the large growth on the right side. The tumors sprang from the sites of holes pierced through the lobe of the ear. The patient also has a similar growth over the right buttock arising in the scar of a burn. The tumors grew rapidly for several months and have remained about the same size for more than a year.

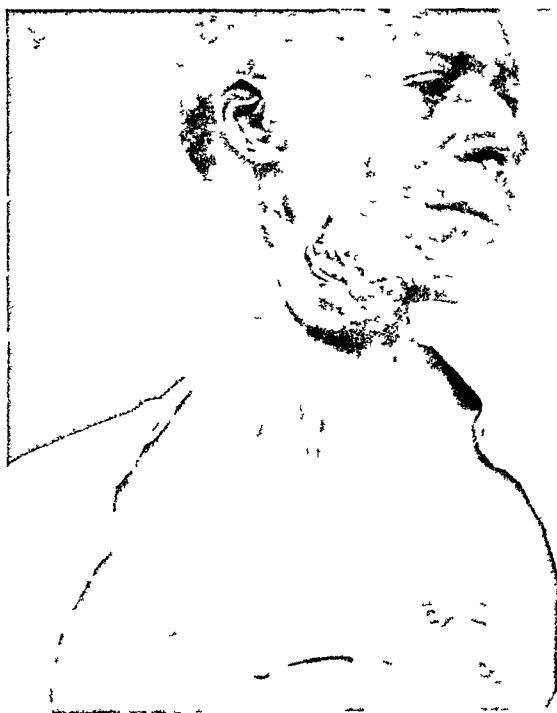


FIG 3 —A case of keloid formation over the chest in old syphilitic scars. The negro tells an interesting story, that he was born with two child's hands crossed on his breast and picks up small money by showing them to those curious enough to look. There is also a keloid mass just under the lower jaw on the right side occurring in the scar of an old cut. It is interesting that a number of individuals in this same family bear keloids developing in scars the result of injuries of different natures. I know of keloids in a nephew and a niece, one occurring in the scar of a broken-down tuberculous gland and the other in a scar of a burn.

JOINT MOUSE

end of the thumb could be felt in the lateral part of the joint, slipping about under the examining fingers

Operation (April 13, 1914) —Under ether the joint mouse was located in the lateral part of the joint, and, while I held it between my fingers, my assistant made an incision, about 6 cm in length, through the skin directly over it, and then an incision, about 3 cm. in length, through the capsule. A quantity of reddish, straw-colored fluid escaped. With a pair of toothed forceps the assistant seized the body and withdrew it. The wound was then sewed up with catgut in layers.

The subsequent course was uneventful. The patient walked with crutches on the tenth day, and left the hospital on the thirteenth day.

The joint mouse was a disc-shaped piece of glistening, normal-appearing cartilage, $27.5 \times 22.5 \times 10.5$ mm in diameter, perfectly smooth on one side, but more uneven on the other (Fig 1). One of its borders was notched. Its uneven side was covered with what appeared to be a thin layer of fibrous tissue. The body looked as if it had come from the condyle of the femur. On section it was found to consist exclusively of cartilage.

An anteroposterior skiagram of the knee showed an area of rarefaction in the medial condyle of the femur (Fig 2), closely corresponding to the shape of the loose body, and a lateral skiagram showed a production of bone on the anterior surface of the medial condyle, corresponding again to the size of the body, and looking as if it had taken the place of the lost cartilage.

Cross-sections were made of the cartilage, imbedded in celloidin, stained with eosin and hæmatoxylin, and by Van Gieson method, and mounted in balsam.

Microscopical Examination —This showed that the body was made up of cartilage throughout, except for a thin layer of new connective tissue on the surface towards the femur.

In the most superficial part of the superficial layer (the narrowest), the cells are arranged parallel to the surface, as in an articular cartilage. Deeper in, they are in larger groups and have lost their parallel arrangement. They are without capsule, and resemble fibroblasts rather than cartilage cells. Most of them are fusiform. They are arranged singly or in groups of two, three or more. Their nuclei stain well.

Very close to the surface one sees here and there gaps in the cartilage, filled with fibroblasts and collagen—connective tissue.

In the second zone, wider than the first, the cells are arranged in groups, and throughout each group the matrix stains rather deeply with hæmatoxylin, giving this zone a blue color perceptible to the naked eye. A few of the cells are in their capsules, as shown in the photomicrograph, but for the most part the cells are without capsule, and the cell body

cannot be distinguished from the surrounding matrix. Some cells have lost their nuclei. The general cell arrangement is perpendicular to the surface.

In the third layer, the deepest of the three, the cells have no definite alignment, and are arranged in groups of two to ten or more. Many of them are dead, but many stain well, and show definite capsules. The diffuse blue stain seen in the second layer is not present here.

Deep in the third layer, at or very near its lower limit, are gaps or cavities of larger or smaller size containing more or less detritus and some calcified material. The walls of these cavities show for the most part a thin layer of calcification.

Below the cartilage again—that is, on the under surface of the body—is the layer of connective tissue. This consists largely of young, cellular fibrous tissue, which either borders directly upon the cartilage or is separated from it in places by a layer composed of cartilage cells in a collagen matrix, looking much like fibrocartilage. For the most part these two layers are rather sharply marked off from each other by a condensation of fibroblasts, but occasionally the boundary between the two is not well defined. Three or four giant-cells can be seen in the young fibrous tissue, looking like typical marrow megaloblasts.

We shall not build up an elaborate theory of the origin of "Gelenkmause" from this specimen, but several points are worthy of mention.

1 The body originated almost undoubtedly from the medial femoral condyle, as shown by the Rontgen picture.

2 Its former site has been filled with bone, as shown by the Rontgen picture.

3 Its comparatively smooth femoral surface covered completely with new fibrous tissue, and the absence of any bone spicules or of marrow, show that it was not broken off immediately by the injury.

4 While many of the cartilage cells are dead, distinct evidences of proliferation are present. The body is thicker than the normal femoral cartilage. This demonstrates that the cartilage could not have been killed at the time of injury, and then have been dissected off later by the marrow, as in the recent experiments of Axhausen on animals' cartilages.

KELOID FORMATION IN THE NEGRO⁺

BY ADDISON G. BRENNER, M.D.
OF CHARLOTTE, N. C.

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FIG 3 —A case of keloid formation over the chest in old syphilitic scars. The man tells an interesting story that he was born with two child's hands crossed on his breast and pocket of small money by showing them to those curious enough to look. There is also a keloid near the jaw under the lower jaw on the right side occurring in the scar of an old cut. It is interesting that a number of individuals in this same family bear keloids developing in scars the result of various different natures. I know of keloids in a nephew, and a niece one occurring in the scar of a broken-down tuberculous gland and the other in a scar of a burn.

surroundings directly in the process, they differ in this from all known effects of bacteria. Extracellular parasites could only be attributed the power of offering the impetus to change of normal cells into the cells of the tumor and leave the further growth, in consequence of the biological changes, to continue its course. The keloid would be only in its beginning a parasitic disease. Intracellular parasites would have to possess this same peculiarity of behavior, which has never yet been seen in the case of any known parasite. It could only be an absolutely specific adaption of the parasite to the tumor, which is so perfect that it immediately becomes absorbed by the cells from which the growth springs, and the idea that there is a particular causative bacterium, simply to agree with the law of specificity of bacterial action, is not at all substantial. For how can one imagine a parasite which may affect certain cells, prompt them to continuous growth and immediately lose the power to affect other cells!

Even in granting that the keloid, like other fibromata, is a neoplasm due to definite defects of normal tissue cells, the cause is still obscure. We know only that the etiological factors must so act as to produce these changes in the cells. And all theories of etiology which do not consider the histogenetic and biological facts are worthless. There are, however, many possibilities which remain and can be divided into two large groups, according as one may attribute the origin to congenital malformation or to outward irritation.

Hereditary dispositions, with the elimination of every other acquired cause, are very difficult to prove. It is accepted, however, that many tumors arise from congenital malformations and from misplaced germinal cells, others show no such indication. On the other hand, we observe a striking relation between an outward injury and the formation of tumors. There are thousands of cases already recorded where tumors follow traumatic, thermic and radial injury. Even normal cells are prompted to proliferation and alteration by such injuries, but there is a return to normal or to a state of equilibrium of growth. Whatever checking force or inhibitory substance there is to control the growth and shaping of the body tissues again exerts its influence. It would seem that, in the case of normal cells, there is first a paralysis and then a regeneration of some inhibitory substance, while, in case of tumor cells, the paralysis is followed by a more or less feeble restoration of this inhibitory substance. It remains a vague speculation as to what this inhibitory influence is, whether it be a substance in the blood serum, the nervous system through so-called trophic nerves or locally, the cohesion of the cells.

Can irritation so act as to produce a paralysis of an inhibition of growth? We know that normal cells are checked in their overgrowth at a certain point by some inhibitory influence. When, on the other hand, cancer cells are irritated, the capability of restitution is seen to be entirely wanting or very feeble. This fact is based on many clinical observations and is shown brilliantly in a few of the researches carried out by Ehrlich. According to him, through the effect of moderate heat and cold, slowly growing cancer cells in mice could be brought to a rapid proliferation without check. Michaelis was able to produce, through warming the cells to 45°C , a lasting increase in volume of cancers in mice. Along this same line the work of Clowes and Baeslack showed that cancer cells, through warming to 37° to 40°C , could be made to take on a lasting continuous accelerated growth, but this action was shown to take effect only on the slow growing tumors which are less inclined to degenerate. As with normal tissue, every irritation producing overgrowth depends upon the removal of some inhibitory substance. The above experiments agree with the law. The difference with cancer cells is that the growth continues its gained activity and that a selective action of stimuli, as to quality and time of application, is not necessary.

The difference then between normal cells and tumor cells rests upon three factors. First, the power of checking a growth once begun and restoration to an equilibrium of growth, as occurs with normal cells, does not prevail. This difference in the cells themselves is certainly necessary for the development of a tumor. The condition is produced by some irritant paralyzing the growth—checking influence. If the power of regeneration of this inhibitory force preponderates over its destruction by the irritant, the growth must sooner or later terminate because the inhibitory force is restored to normal. In such a case, not a malignant but a more or less malignant tumor arises. Second, if even as much inhibitory substance regenerates as is destroyed, then inhibition of growth remains unchanged and a normal development takes place, a lasting continuous growth (a cancer) takes place as soon as the inhibitory action is removed through irritation. Third, if the capability of restitution has sunk so far that the irritation destroys more of the inhibitory substance than is formed, then a rapidity of growth takes place, more and more rapid, until an indefinite maximum is reached, that is, a cancer is formed.

These factors just cited would serve to explain the development and growth of keloids, as well as other tumors. In the case pictured in Figs 1 and 2 it is seen that a keloid may arise following an irrita-

KELOID FORMATION IN THE NEGRO

tion of the slightest intensity Cancer cells can be made to grow rapidly following the slightest irritation In the case of the keloid there is evidence to show both a single and multiple response, through growth, in various parts of the body of the same individual and to irritants of different character, in Fig 3 is seen a keloid arising from an old cut under the jaw and another from an old syphilitic scar over the chest The irritant, of whatever character, acts by overpowering the inhibitory substance and the cells are allowed to grow The fact that a keloid appears spontaneously may mean only that the irritant has been mild and has gone unnoticed The fact that some keloids disappear spontaneously may mean, on the other hand, that the inhibitory substance has regenerated

Why are keloids so much more frequent in the negro than in the white man? The negro is much more susceptible to all connective-tissue tumors than the white man, about 2 to 1. The negro at birth shows many gross congenital malformations and, on the dissecting table, many anomalies of blood-vessel and nerve formations confuse the student as he follows his text-book guide These perverted structural conditions point to an instability in the equilibrium of growth There must be some disturbance of an inhibitory influence which holds the growth of the cells in check and prevents their growth at random If the abnormal growth of cells is due to an injury of an inhibitory substance, this substance must first be injured before the cells can grow This inhibitory substance is then more sensitive than the cells themselves If we possess evidence of a much greater preponderance of abnormalities of growth and tumor formation in the negro than in the white man, we may know that this inhibitory substance is weaker and more unstable than in the white man Therefore, irritation which might pass without a demonstrable effect in the white man, might so injure this inhibitory substance in the negro as to allow an overgrowth of the dermal connective-tissue cells and the formation of a fibroma, a keloid

FIXATION OF SIMPLE FRACTURES

By JOHN O'CONOR, M.D.

OF BULNOS AYRES

SENIOR MEDICAL OFFICER OF THE BRITISH HOSPITAL

It seems somewhat of an anachronism that, even with the assistance of skiagraphy, some standard has not yet been fixed whereby we might harmonize our treatment of simple fractures in conformity with the facilities which modern surgery affords, and in consonance with the natural factors which govern the repair of living tissue

Judging from some recent publications, there appears to be a tendency to ignore the fundamental basis of our healing art—rest. Early massage, early movement, indeed ambulatory treatment have their advocates, who repeatedly ventilate the perfection of their respective procedures, and, in order to show the valuation which they place on nature's remedy, such volcanic organisms as cats are taken as suitable experimental mediums on which to found theories, and to condemn the cumulative experience of ages, so well expressed in the classic work of Hilton, which, by the way, in my humble opinion, possesses even greater value to-day than when first published

If one pauses to consider the rationale of the treatment of any injury, be it of bone or flesh, surely it is absurd to think that any wound can be cured by surgery *per se*, living bone is not wood that can be hammered and indefinitely held together by bolts or nails. Living cells with their living cement are the primordial factor in the business, and the object of surgery is not to displace but assist the natural process of repair, by removing such conditions as may hamper the osteoblasts in the execution of their great and secret mission

It has fallen to my lot to have had a quarter of a century's hospital experience in the treatment of fractures, the total of which runs into four figures, and consequently I have had the opportunity of forming some ideas on the subject, one of which is, that it requires 30 days' absolute rest on a properly adjusted splint for the callus to set in the fracture of a long bone of any healthy adult, quite irrespective of the means, surgical or otherwise, by which correct apposition has been secured. Not being endowed with an over conservative turn of mind, I have been tempted from time to time to try some of the would-be time-saving methods, but sooner or later found them to be time-losing ones, and so prolific in regrettable incidents that I am now forced to con-

FIXATION OF SIMPLE FRACTURES

tent myself with nature's mandate—put the fragments in apposition, keep them in it, and leave them at rest.

I do not think it is exaggeration to state that the reparative process attending a radical cure of hernia, or a perineoplasty, is identical to what takes place in the union of a broken bone. But I have yet to find the person who advocates early muscular movement or ambulatory treatment in the former conditions. In particular, I wish to note the similarity in the healing of wounds of bone and perineum, in that the rapidity of union seems to be in direct ratio to the rapidity in which the severed parts are approximated. And although the same cellular law applies equally to the cure of a ruptured perineum or recent fracture, the surgical conditions are very different, in the former the surgeon is assisted by the use of his eye-sight, but in the latter, even with the aid of X-rays, it is almost impossible to exclude the presence of interposing strips of torn muscle, periosteum, and clots—a difficulty particularly accentuated in the very common oblique spiral fractures.

During the past three years I have had the embarrassing experience of finding in six cases of simple fracture of the shaft of the tibia no attempt at union after five weeks' careful splint treatment, in each little or no deformity existed, and alignment appeared normal, but at subsequent operation torn masses of muscle were found wedged between the fragments in four, and in two an overlapping curtain of torn periosteum. This kind of thing is, indeed, bewildering, not only as to the commercial loss of valuable time to the patient, but in the reflection that the osteoblastic tide has ebbed, which, taken on the flood, adds so much to rapid and sound union.

The "wait and see" theory may be a useful formula for the expectant politician, but remembering the fact that the cementing activity of the osteoblasts seems to decrease in direct ratio to the delay in which their services are utilized, I am not at all sure that it is a good one for even the expectant surgeon.

My experience has forced me to adopt the more direct one, "look and see," and I confess the more I do see, the more I wonder, considering potential inhibitory obstacles, at the marvellous reparative power the human body possesses, in that an oblique fracture of any long bone ever unites without operative assistance.

And moreover I venture to state that, considering the favors which Lister and Lane have conferred on bone surgery, it is mocking reason, knowing the handicap which the natural curative process has to carry in such cases, not to seize the earliest opportunity of removing interpos-

ing "foreign bodies," and to effectively overcome displacement caused by powerful muscular traction.

Doubtless these statements will be reckoned rank heresy by those, for example, who possess the faculty of diagnosing the exact pathological condition of an infected appendix without the employment of the sense of sight. But even at the risk of being outlawed for my lack of perspicacity, I confess I can no more prophesy that an oblique fracture of the tibia or femur will be united in six weeks without operation than I can that an infected appendix will not perforate within forty-eight hours.

I am unable to follow the reasoning of those who advocate early movement, for in the many cases in which there is mechanical obstruction to approximation of fragments, it can only result in making confusion worse confounded.

As to its use in conjunction with the application of bolts or plates, except in diseased conditions or old age, the one appears to me to be the negation of the other, not to mention the fact that it is usually the custom to allow time for a plaster case to set before the patient is allowed to move it. And finally, as to the value of early massage, after giving it a trial for two years, we came to the conclusion that its virtues—diminution of pain and swelling, and prevention of stiffening of joints—were more than compensated by its defects—unexpected displacement of fragments, and an increased percentage of ununited fractures.

Consequently I made it a rule to defer its benefits for four weeks, until union was established.

In order to make matters clear, it may be well to state my practice in detail.

Assisted by X-rays, I treat simple transverse fractures by absolute rest on splints, if at the end of four weeks union appears defective, I operate, remove any intervening tissue, revivify the surface of fragments and plate. In all oblique fractures I operate as soon as I have completed the necessary technical dispositions, so as to insure an aseptic wound.

During the past twenty years I have used wire in scores of cases (during later years strong eleven-day catgut), but since I adopted Sir Arbuthnot Lane's method I have found that I can do in ten to twenty minutes infinitely better work with much less disturbance of parts, and consequently much less risk of supervention of sepsis.

I regret that I did not adopt this procedure years ago, as it would have obviated, to say the least, much temporary annoyance when the twisted wire broke, or the fragments slipped their moorings on ad-

justment of splint. With Lane's plates a surgeon has at his disposal the easiest means that I know of of securing rest to the parts, they assure retention of fragments in exact position, cause no irritation, and it is extraordinary, as I have frequently demonstrated to onlookers, the ivy-like manner in which the periosteum covers and caresses the underlying plates

I consider it a duty to take this opportunity of refuting a statement made in a recent Hunterian lecture that "the screws loosen after a short time," and are consequently useless! I much regret that a distinguished surgeon, for whom I have the most profound respect, should have his name associated with such a travesty of fact. Many of the patients on whom I have operated are railway employees, and as they were particularly exposed to injuries, I considered it expedient to remove the plates before they left the hospital

Knowing what Sir William Macewen's ideas were with regard to the effective duration of ligatures, pins, etc., in the living body, I was much astonished to find in my first case that it was impossible to pry the plate out of its position by a strong elevator, and I was further more surprised to find that the screws retained their grip so tenaciously for six weeks, that I had to use almost as much force in unscrewing them as I had to insert them.

Being much interested in the matter, I purposely invited my colleagues to witness ten consecutive removals result—in not a single instance was it found possible to remove the plate without the employment of the screw-driver

Since this paragraph was written I have had the opportunity of further verifying the matter. Two patients were plated on January 29 for simple fracture of shaft of tibia, and removal of plates was deferred to the fifty-third day, so as to intensify the test, and in order to expunge the personal element, I invited my colleague Dr Healy to remove the plates, each of which contained six screws; he, too, found it impossible to remove a single screw without the turn-screw, and, moreover, called my attention to the circular indentations which the screw holes in plates had made in the bone. In both cases the periosteum, plate and bone seemed one naturally welded mass

The method of operating by which I obtain such results is as follows.

The part is well painted with tincture of iodine, and the whole field isolated by dry sterilized towels. Taking the line of fracture as centre, a four to six inch incision is made along aspect of bone in which there is the least danger of injuring anatomical structures; whenever feasible, as in tibia, the knife is inserted at one extremity of line of incision and

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Assisted by X-rays, I treat simple transverse fractures by absolute rest on splints, if at the end of four weeks union appears defective, I operate, remove any intervening tissue, revivify the surface of fragments and plate. In all oblique fractures I operate as soon as I have completed the necessary technical dispositions, so as to insure an aseptic wound.

During the past twenty years I have used wire in scores of cases (during later years strong eleven-day catgut), but since I adopted Sir Arbuthnot Lane's method I have found that I can do in ten to twenty minutes infinitely better work with much less disturbance of parts, and consequently much less risk of supervention of sepsis.

I regret that I did not adopt this procedure years ago, as it would have obviated, to say the least, much temporary annoyance when the twisted wire broke, or the fragments slipped their moorings on ad-

justment of splint With Lane's plates a surgeon has at his disposal the easiest means that I know of of securing rest to the parts, they assure retention of fragments in exact position, cause no irritation, and it is extraordinary, as I have frequently demonstrated to onlookers, the ivy-like manner in which the periosteum covers and caresses the underlying plates

I consider it a duty to take this opportunity of refuting a statement made in a recent Hunterian lecture that "the screws loosen after a short time," and are consequently useless! I much regret that a distinguished surgeon, for whom I have the most profound respect, should have his name associated with such a travesty of fact Many of the patients on whom I have operated are railway employees, and as they were particularly exposed to injuries, I considered it expedient to remove the plates before they left the hospital

Knowing what Sir William Macewen's ideas were with regard to the effective duration of ligatures, pins, etc., in the living body, I was much astonished to find in my first case that it was impossible to pry the plate out of its position by a strong elevator, and I was further more surprised to find that the screws retained their grip so tenaciously for six weeks, that I had to use almost as much force in unscrewing them as I had to insert them

Being much interested in the matter, I purposely invited my colleagues to witness ten consecutive removals result—in not a single instance was it found possible to remove the plate without the employment of the screw-driver.

Since this paragraph was written I have had the opportunity of further verifying the matter Two patients were plated on January 29 for simple fracture of shaft of tibia, and removal of plates was deferred to the fifty-third day, so as to intensify the test, and in order to expunge the personal element, I invited my colleague Dr. Healy to remove the plates, each of which contained six screws, he, too, found it impossible to remove a single screw without the turn-screw, and, moreover, called my attention to the circular indentations which the screw holes in plates had made in the bone In both cases the periosteum, plate and bone seemed one naturally welded mass

The method of operating by which I obtain such results is as follows

The part is well painted with tincture of iodine, and the whole field isolated by dry sterilized towels Taking the line of fracture as centre, a four to six inch incision is made along aspect of bone in which there is the least danger of injuring anatomical structures, whenever feasible, as in tibia, the knife is inserted at one extremity of line of incision and

made to sever all the structures, including periosteum, in one sweep right through the whole length of wound, the periosteal elevator is at once applied and the flaps retracted in mass

In my opinion this is a most important detail, for it obviates dissecting room manœuvres which cause unnecessary exposure of planes of areolar tissue, and the formation of potential spaces for the incubation of germs, and, furthermore, considerably facilitates approximation of edges of periosteum by interrupted through-and-through strong silk sutures

If necessary, I never hesitate to protrude the fragments, in order to carry out proper inspection and thorough removal of buffers of torn tissue and clots, and, moreover, I frequently use a saw or bone-cutting forceps to dress the fragments, so that the surfaces of same may remain in the best possible position and condition for union. No tourniquet is employed, bleeding points are ligated, and sutures so inserted as not only to encircle the periosteal edges, but placed at a sufficient distance apart so as to provide for automatic drainage in case of subsequent oozing. And it is well to remember that the value of through-and-through sutures for deep approximation purposes depends entirely on their being properly tied, viz, tension made and knots placed at stitch-holes along one side of wound. If there should be the slightest sign of shock in this, or any other operation, nothing in my experience equals a rectal injection of a pint of champagne

No extension apparatus is made use of, splints are carefully adjusted, and at the end of each week the nurse changes the dry gauze dressing. After the thirtieth day, the splint is daily temporarily removed, and the patient requested and encouraged to gently move the corresponding joints, the limb is then replaced on splint and gently massaged for ten minutes. On the forty-second day the splint is dispensed with, and massage and active movement are carried out daily until he can walk. As before stated, the plates are removed at end of sixth week, massage is, of course, omitted during the few days necessary for the healing of this wound

If there is one point that I should single out for especial consideration in this operation, it is efficient approximation of divided periosteum, not only with the idea of securing the plates in good position, but of preventing the entrance of militant germs to the seat of osteal repair, and of preventing the escape of osteoblasts into the surrounding tissues and depositing the nuclei for the formation of masses of callus, which are afterwards a bugbear to both patient and surgeon

I have observed that these formations are much less frequent in

simple fractures which have been operated on than in those which have not, obviously the result of want of closure of periosteal tear in latter.

Again, if there is a point in the after-treatment which I should select for particular censure, it is what has been falsely described as "passive," but which I can only describe as damnation, movement of joints. During my twenty-five years' experience I have seen more joints permanently maimed by those obsessed with this relic of the Inquisition than I have seen by the ravages of the bacillus of Koch. And nothing in surgery gives me greater cause for anxiety than the application of my hands to break down adhesions in joints, for I am convinced that in at least 90 per cent of such cases the patient's own muscles, guarded by his own sense of pain, are the one and only treatment necessary or justifiable.

Being aware of the danger I incur of starting a correspondence on the craze for early osteopexy, it may be expedient to define my position.

This paper is not written with the idea of tempting men, who have neither the skill nor means of doing such an operation in an aseptic manner, to plunge a knife into every case of oblique fracture they come across, indeed, such a result would be too awful to contemplate, but it is penned with the object of inviting the attention of those who possess the means, and are capable, to reconsider present methods, and, if possible, to take full advantage of the services which surgery affords in the treatment of common lesions which are often attended with most undesirable consequences.

TENDON FIXATION FOR DEFORMITY RESULTING FROM PARTIAL PARALYSIS

BY W. E. GALLIE, M B .

OF TORONTO, ONTARIO

ASSOCIATE SURGEON, HOSPITAL FOR SICK CHILDREN

THE following is a report of a further development of the operation described by the writer, under the title "Tendon Fixation," in the ANNALS OF SURGERY, March, 1913

The patient was a boy of five years of age, who had had anterior poliomyelitis two years before, resulting in extensive paralysis of the right lower extremity. From this he gradually recovered until he was able to walk, although with considerable disability, owing to a residual partial paralysis of the calf muscles and a complete paralysis of the tibialis posticus. Upon examination the calf muscle seemed to have about one-quarter of the normal power, the tibialis posticus no power at all, and the peronei, tibialis anticus, dorsi flexors and plantar flexors of the toes about normal power. The result was a moderate calcaneovalgus, the patient walking entirely on the heel and with considerable valgus, apparently making no use of the power still persisting in the calf.

Encouraged by the success met with in the series of 50 cases in which the writer has done tendon fixation for the various deformities resulting from complete paralysis of groups of muscles, the following operation was done

A vertical incision five inches long was made along the outer side of the tendo achillis, down to the posterior extremity of the os calcis. The sheath of the tendo achillis was split throughout the length of the incision and the tendon exposed. The tendon was then split into an anterior and a posterior half from the upper end of the incision down to the os calcis. At the upper end of this incision the anterior half of the tendon was then cut free from the muscle. Close to the insertion of the tendon a small opening was made in the anterior portion of its sheath and the cut end of the half tendon drawn through it so that it was now entirely anterior to the sheath. The posterior surface of the tibia was then exposed by retraction of the flexor longus hallucis and the periosteum divided vertically for three inches, down to the lower end of the bone. After reflecting the periosteum sufficiently a piece of bone, three inches long and of the thickness of the half tendon, was removed with a gouge and the tendon laid in the trough thus pre-

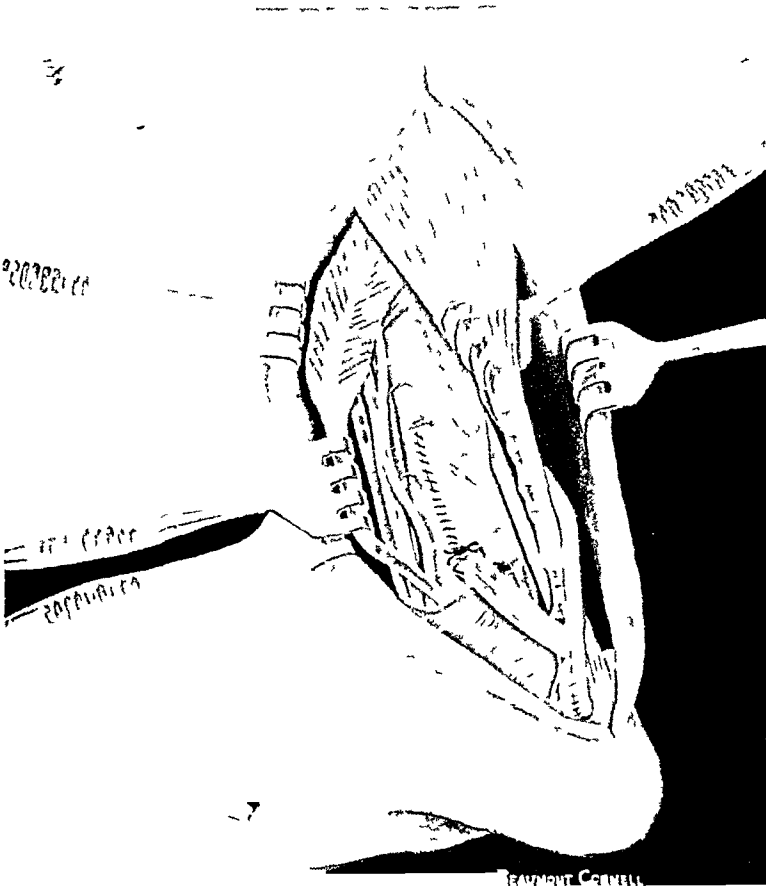


FIG 1 —The drawing shows the flexor longus hallucis retracted so as to expose the posterior surface of the tibia. The anterior half of the tendo achillis has been sewn into the groove in the bone. The incision in the sheath of the tendo achillis has been closed and the two peronei tendons have been transplanted into the os calcis.

TENDON FIXATION FOR DEFORMITY

pared When this tendon had been drawn sufficiently taut to produce a slight equinus, it was sewn solidly in place with kangaroo tendon and catgut and completely covered with periosteum Thus, passive or active dorsiflexion of the foot beyond a slight obtuse angle was made impossible

The peronei tendons were then transplanted into the os calcis and, finally, a fixation was done on the tibialis posticus tendon to prevent the valgus deformity, the tendon being buried in the internal malleolus in the manner previously described

Healing took place by primary union and after two months the plaster was removed The fixations were quite solid and the peroneal transplantation successful The part of the tendo achillis still attached to the muscle had regained its normal thickness as far as one could tell The point of greatest interest, however, was that while dorsiflexion beyond a slight obtuse angle was impossible, the patient was able to plantar-flex the foot strongly by the combined action of the calf muscle and the transplanted peronei Thus the deformity and disability were overcome without interference with the power present Furthermore, after the lapse of a few weeks, during which time proper exercise was given, the power in the weak calf muscle had decidedly increased, indicating at once that a part at least of the weakness of the muscle was due to its stretched condition in calcaneus With the assistance of a Whitman plate the patient walks nearly normally

It is the intention of the writer to use this method on a series of suitable cases in which deformities are present in spite of a partial recovery of the muscle If the fixations prove as successful as they have done in the case of the operations in which the whole tendon was fixed for a complete paralysis, a new operative field will have been opened up which will completely eliminate the silk ligament and reduce to a minimum the necessity for braces in infantile paralysis

BLOOD-VESSEL CLAMPS OF PRACTICAL UTILITY*

By BERTRAM M. BERNHEIM, M.D.

OF BALTIMORE, MD

INSTRUCTOR IN CLINICAL SURGERY, THE JOHNS HOPKINS UNIVERSITY

IN company with the development of blood-vessel surgery, various instruments to facilitate the work were devised, and when methods, perfected in the laboratory, were applied to human problems it was assumed that the same instruments would be equally satisfactory. This transfer has only been partly feasible, an example of non-adaptability being the blood-vessel clamp. For animals the Crile clamp served all purposes—somewhat clumsy, perhaps, but, since the exposure in experimental work is not of great importance, satisfactory. In operations on humans it has been constantly troublesome. To supply the deficiency, I have devised the compact, powerful screw-clamp (Fig 1), here so realistically illustrated that detailed description is not necessary. This clamp has the virtue of requiring little space (Fig 3), being easy of application and removal and absolutely adjustable. It cannot slip, and the rounded edges preclude the possibility of injuring the vessels.¹

In transfusion work and other manipulations of the smaller vessels, the old rubber-shod bull-dog clamp has done noble service for many years—but it is cumbersome and tends to slip. By removing the serrations, carefully rounding all edges, and turning up the ends of the blades at right angles (Fig 2), I have formed a very useful little instrument which cannot injure the vessel wall and cannot slip. It takes up extremely little space (Fig 4).

These clamps have been given thorough practical trial and found to be most helpful.

* From the Hunterian Laboratory of Experimental Medicine, The Johns Hopkins University

¹ This clamp is made in two sizes—one to fit the vessels of the extremities, the other for the larger vessels of the abdomen and root of the neck.

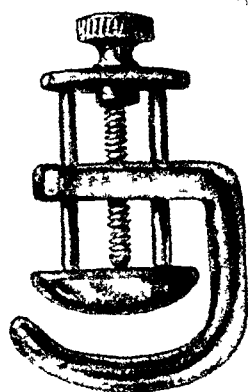


FIG 1 —Screw clamp for large blood-vessels

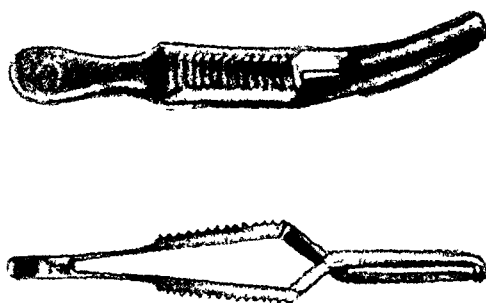


FIG 2 —Clamp for small vessels , especially useful in transfusions



FIG 3 —Screw clamps being used in suture of femoral artery They occupy very little space

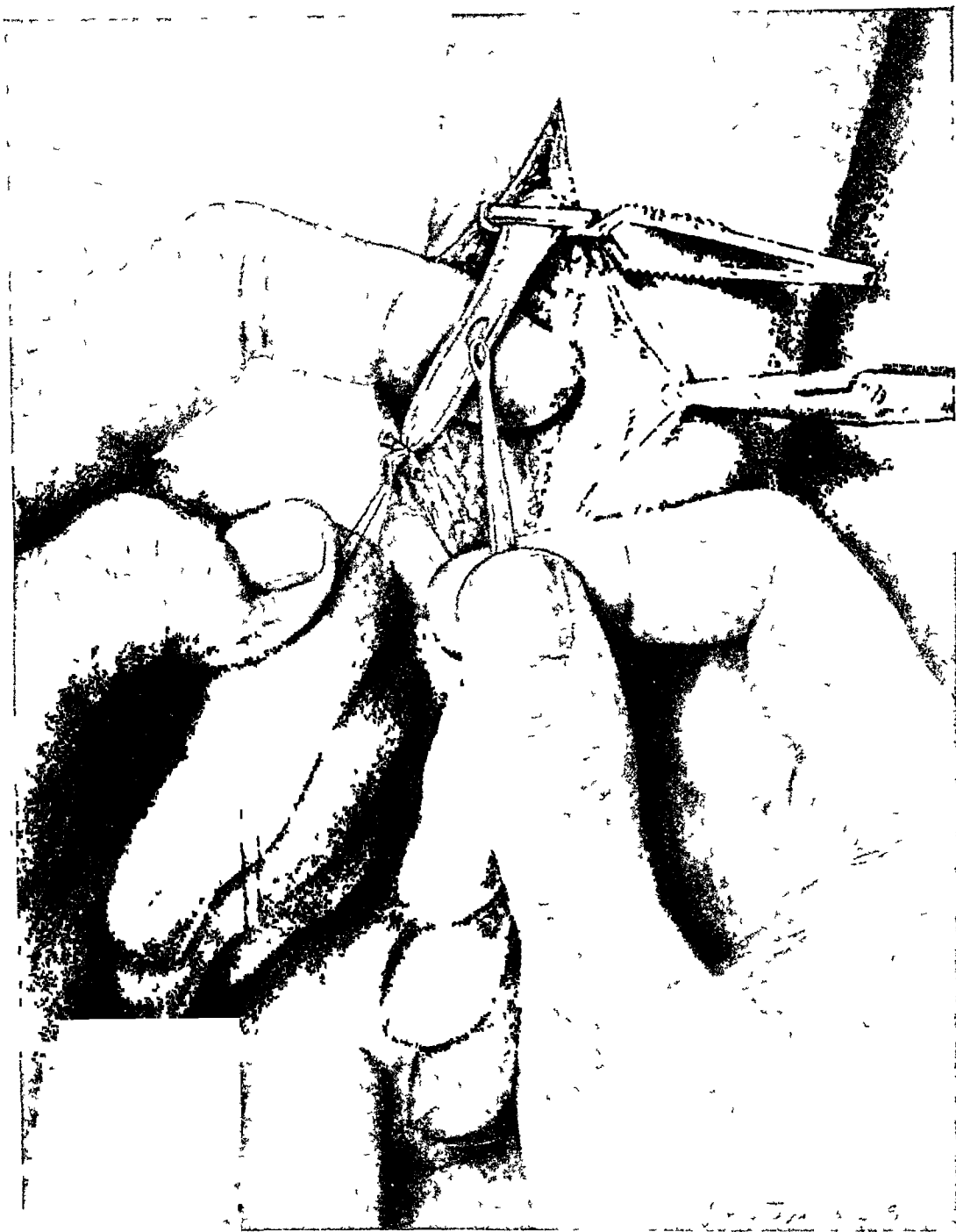


FIG 4 —Clamp being used in a transfusion Its right-angled end prevents slipping

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY

Stated Meeting, held at the New York Academy of Medicine, October 14, 1914

The Vice-President, DR. CHARLES H. PECK, in the Chair

SYPHILITIC LESION SIMULATING CEREBELLAR ABSCESS

DR. JOHN A. HARTWELL presented a woman, thirty-two years old, who was admitted to Bellevue Hospital on September 10, 1914, with the history that in July, 1914, she had an acute otitis media on the right side which was suspected to have involved the mastoid. No operation, however, was advised. The discharge from the ear persisted, and about August 10 she began to suffer from headache, which had steadily grown worse, and coincident with this there was pain over the mastoid. During the past week she had grown very unsteady in her gait and had complained somewhat of dizziness. There had been no nausea or vomiting.

On admission, the patient showed every evidence of suffering acutely from headache, which she located as most severe in the occipital and frontal regions, there being no difference in degree on the two sides. From the right ear there was a scanty, thick, very foul discharge, and examination showed a swollen canal and a perforation in the membrane. The mastoid was moderately tender on pressure. Percussion over the posterior portion of the right temporoparietal region caused pain, while the remainder of the head was free from this sign.

Eyes. The pupils were equal in size and in their reactions to light and accommodation. There were no abnormalities in the ocular movements. Both fundi were congested, with dilated and tortuous vessels, retinal hemorrhages and cedema of the discs, so that their outlines could not be determined. These conditions were more marked in the left than in the right fundus.

Reflexes. All the reflexes were normal and equal excepting the left abdominal reflex, which was totally absent. There were no paralyses and no evidences of superficial sensory disturbances. There was, however, a marked disturbance of equilibrium. The patient on standing

swayed markedly, even with the eyes open, and after a few seconds pitched forward and to the left. With the eyes closed this sign was much increased. In attempting to walk she staggered, the usual tendency being to the left. The feet were not lifted from the floor, but the gait was a shuffling stagger. No muscular incoordination could be demonstrated in the upper extremities, and when lying down, coordinated movements of the lower extremities were executed.

On the left tibia there was a thickening in the middle third, occupying the subcutaneous surface and crest, about 3 x 5 cm in extent. This was strongly suggestive of a syphilitic periostitis. There was, however, no other evidence of such an infection elsewhere on the body.

The temperature varied from 97° to 99° during the first forty-eight hours after admission. The pulse was about 90. The systolic blood-pressure was 150 mm, the diastolic 100 mm.

A lumbar puncture was cautiously done, with the patient's head low, the danger of this procedure being recognized. Clear fluid spurted out with great force, and coincident with this the patient cried out with pain in the front of the head, but with no change in pulse or respiration. The flow was immediately checked and no fluid was collected for examination. The intense frontal pain continued for ten minutes.

This patient's history, in connection with the findings above detailed, suggested either a cerebellar abscess or a syphilitic lesion. The possibility of the latter was recognized, but the patient's condition was so urgent and the probability of a cerebellar or post-temporal abscess so emphatic, with the danger of rupture and sudden death, that it was decided to operate at once, and not await the result of the Wassermann test or of antisyphilitic treatment.

The usual mastoid operation was done and the skull removed posteriorly and upward so as to expose both the cerebellum and the temporo-sphenoidal region. The antrum contained granulation tissue; there was necrosis of its walls, and the bone extending backward along the sinus was also necrotic. The sinus itself, as far as it was exposed, was converted into a solid fibrous cord and contained no blood. The dura around it was markedly thickened and adherent to the pia arachnoid. This condition was found to be more apparent over the cerebellum than over the temporal region. The intracranial tension was markedly increased wherever the meninges were exposed, and no pulsation was present. On opening the thickened dura the temporal lobe and the cerebellum both bulged markedly into the wound. There was no excess of cerebral fluid. The finger was passed beneath the temporal lobe and the cerebellum in search of a subdural abscess, but none was located. A puncture was

SEPARATION OF LOWER FEMORAL EPIPHYSIS

made into each of these parts with a brain trocar-cannula, but no fluid pus could be obtained. The type of the meningitis and the fibrous cord replacing the sinus indicated that these changes were syphilitic rather than directly secondary to the mastoiditis, and no further attempt to locate an abscess was made.

The subsequent course of the disease was steadily towards recovery. Mercury and iodide had been given in full doses. The operative wounds had healed in the usual way, only a small sinus now remaining. The eye-grounds had gradually regained an almost normal appearance, but there still remained some indistinctness of the disc and traces of the old hemorrhages (Dr Vandegrift). The intracranial tension was still above normal, as shown by the protrusion of both the temporal lobe and the cerebellum, both, however, pulsating. The gait had become normal and the headaches had entirely disappeared. The Wassermann reaction, immediately after the operation, was strongly positive. The lateral sinus, which was excised at the operation, showed a chronic inflammation, and the bone from the mastoid, a chronic osteitis. In neither tissue could any evidence be found that would justify even a possible diagnosis of syphilis.

A spinal puncture was done on October 10, 1914, and the fluid was clear and under normal pressure. The Wassermann reaction with this fluid was negative, the globulin was not increased but there were reducing substances present. On this date the blood also gave a negative Wassermann reaction.

There still remained some doubt, Dr Hartwell said, as to whether the decompressive operation or the administration of the mercury and iodide was the cause of the improvement that had taken place. The fact that the brain protruded through the openings in the skull seemed to indicate that there was still intracranial tension, and there was even a possibility of a latent abscess. Further observation of the case would probably solve these two questions, and the speaker said he hoped to be able to report further developments at some future date.

SEPARATION OF THE LOWER FEMORAL EPIPHYSIS

DR FRANK S. MATHEWS presented a little boy who was brought to St. Mary's Hospital for Children two months ago, with the history that two months previous to that date he had met with an injury, sustaining a fracture of the left tibia and fibula, together with a separation and displacement of the lower femoral epiphysis. The fractures had apparently been recognized at the time of the injury and satisfactorily treated, but the separation of the epiphysis had been overlooked, and

the epiphysis had firmly united with the front of the shaft of the femur

Dr Mathews said that in spite of some compunctions about operating after the lapse of two months, he made an external incision and cut away the surrounding callus, which was quite as firm as normal bone, and then, with considerable effort, he was able to pry the displaced epiphysis over the end of the shaft. During the first few days following the operation the epiphysis was retained in place by keeping the knee in a strongly flexed position, and then straightened.

In several cases of this injury that were on record there was apparently no arrest of growth. In one of these, as in this case, the operation was done about two months after the injury. In another case the replacement was made immediately, but resulted in one inch shortening.

In reply to a question, Dr Mathews said he had been able to draw the epiphysis into its proper position in this case by hard prying and flexing the knee. This rendered the use of spiking unnecessary, and also obviated the possibility of injury to the knee-joint.

FIBROSARCOMA OF THE LEFT AUDITORY NERVE EXTIRPATION (1908)

DR WILLY MEYER presented a woman, twenty-eight years old, who was referred to him by Dr George W Jacoby in January, 1908, with all the symptoms of a tumor in the cerebellopontine angle, with staggering gait and advanced optic neuritis. Both the left facial and left acoustic nerves were involved.

At the operation, which was done at the German Hospital on January 29, 1908, with the patient in the prone position and under general anæsthesia, the brain was exposed through a large horseshoe-shaped flap over the occiput. The entire os occipitale was removed, the longitudinal sinus was tied and divided, and both cerebellar hemispheres exposed by turning down a heart-shaped flap of the dura mater. With a brain-lifter well in place, a tumor, about the size of a bean, was found and successfully removed. The patient made a good recovery from the operation, but was kept under observation in the hospital for four months. Her gait and eyesight gradually improved, and after two and a half months she was able to count fingers throughout the entire length of the ward.

This patient was originally presented at a meeting of this Society in March, 1908 (ANNALS OF SURGERY, vol XLVIII, p 309), under the title of "Craniotomy for Tumor of the Acoustic Nerve." When she was shown subsequently, in January, 1909 (ANNALS OF SURGERY,

CYST OF THE BRAIN

vol. xlix, p 552), she was able to read and write, do embroidering and housework, and could walk in a straight line. There was at that time a slight facial paresis and, of course, deafness on the affected side. At the present time, almost seven years after the operation, the patient showed no signs of a recurrence and was in excellent condition. She was able to read and write and do her housework, travelled about on the cars unassisted and had again become a useful member of society. Her eyesight, which was almost *nil* before the operation, had improved very much, although a slight blur still persisted.

This operation, Dr Meyer said, was the first time he had resorted to Dawbarn's sequestration method for controlling hemorrhage, with excellent results. This patient now had a very large decompression in the occipital region. Pathologically, the tumor proved to be a fibrosarcoma.

OSTEOPLASTIC RESECTION OF THE SKULL FOR INTRACRANIAL HEMORRHAGE

DR MEYER presented a young man who came under his care in the summer of 1906—eight years ago—with the history that while riding horseback he had been thrown, striking over the right temporal region. He was picked up unconscious and carried home, where he was treated for concussion for forty-eight hours, then, focal symptoms developing, he was brought to the hospital, where further observation made it clear that an intracranial hemorrhage had taken place. The pulse had gradually fallen to 58 per minute and there were evidences of beginning facial palsy.

At the operation, which was done in June, 1906, a horseshoe-shaped osteoplastic flap was turned down over the right temple, and a large blood clot was found epidurally, which was carefully removed. The source of the bleeding could not be made out, but it was evidently a branch of the meningeal artery.

The patient made an uninterrupted recovery, and had remained entirely well since the operation.

CYST OF THE BRAIN DUE TO SHOT-WOUND JACKSONIAN EPILEPSY CRANIOTOMY CURED

DR MEYER presented a man, thirty-seven years old, who, in 1898 while abroad, was shot in the right temporal region. Following the injury the bullet was located by the X-ray in the right frontal lobe and he was advised to leave it undisturbed. He remained perfectly well until 1911, thirteen years after the injury, when he was suddenly seized with an epileptic attack, evidently Jacksonian in type. A few days later he

SEPTIC BRONCHIECTASIS

EXTIRPATION OF THE RIGHT LOWER PULMONARY LOBE FOR SEPTIC BRONCHIECTASIS

DR HOWARD LILIENTHAL presented a boy, four and a half years old, who had been referred to him by Dr Sidney Yankauer. The patient was shown at this time to demonstrate the final result, as the unfinished case had already been reported at the last meeting of the American Surgical Association and was published in the ANNALS OF SURGERY in June, 1914.

When the boy was two and a half years old he aspirated some food, and bronchiectasis of the right lower pulmonary lobe had followed, with increasing exhaustion from cough and sepsis. Dr Yankauer had succeeded in removing much of the foreign matter with the aid of the bronchoscope, but still the cough and sepsis were unrelieved.

On February 27, 1914, the patient was operated on at Mt Sinai Hospital under ether administered by the intrapharyngeal method by Dr Branower. An intercostal incision along the entire lower border of the seventh rib was made, and through the wide opening secured by retraction of the ribs an excellent view of the intrathoracic contents was obtained. The upper lobes were normal in appearance and motion, the lower lobe was liver-colored and tense, and adherent to the diaphragm and chest wall. It was peeled loose, and the stump at the hilum, after crushing with forceps, was secured by a transfixion ligature of chromicized catgut, and the wound closed with gauze drainage. Seventeen days after the operation the stump came away. There was no leakage of air and the phenomenon causing the greatest alarm during the three months of convalescence was tachycardia.

At the present time the patient appeared to be entirely well, and his body was normally developed and symmetrical. The technic employed in this case, Dr Lilienthal said, was necessary because the patient's poor condition demanded haste. He emphasized the importance of bronchoscopy whenever an operation upon the lung was contemplated.

DR FRANZ J A TOREK said Dr Lilienthal did not mention one important point in the technic of this operation, namely, that of leaving a small portion of the lung attached to the pedicle. When this is not done, the bronchus is apt to slip back into the mediastinum and cause mediastinal emphysema, if the ligature fails to hold.

DR WILLY MEYER said there were a number of interesting points in connection with this case. One was the employment of pharyngeal anæsthesia.

In these cases not infrequently the adhesions rendered differential

had a second attack, followed by two others in the course of one month. These attacks were so severe in character that the patient was at times totally incapacitated and he was removed to the hospital, where the bullet was again located with the X-ray and an operation was advised, a cyst of the brain being suspected.

Operation. On turning down the osteoplastic flap there was free hemorrhage, and a number of fragments of the bullet were found in the soft tissues. There was no trace, however, of the bullet itself and no powder marks on the bone. As the brain was not pulsating, a puncture was made near the base, where there seemed to be a scar on the dura mater. Clear fluid was obtained, and immediately the brain began to pulsate. An incision was then made through the thickened dura, allowing a large quantity of clear fluid to escape. Palpation with the finger disclosed the presence of a cavity, and upon enlarging the incision and inserting retractors, the cavity could be inspected, showing the irregular brain outline, and at a depth of about two inches the finger came in contact with the bullet. It was extracted with difficulty, some brain tissue followed. There was pronounced hemorrhage, which was promptly checked by a tamponade. The wound was drained, and the patient made a rapid recovery, leaving the hospital twelve days after the operation. During the next twelve months he had three further epileptic attacks, one in 1911, and two in 1912. For the last two years he had been entirely well and able to attend to his business.

Dr. Meyer said he did not use an elastic band around the head for hæmostasis. In making the incision through the soft parts the hemorrhage was usually slight, as he now always employed Dawbarn's sequestration method. The bleeding vessels were caught with forceps, which were left in place until the completion of the brain operation. The holes in the bone were made with the help of Doyen's and Hudson's drills, and the bone then divided with the Gigli saw. His average time for forming the bone flap was from twenty to thirty minutes.

Dr. CHARLES H. PECK said he had shown a somewhat similar case a number of years ago where epilepsy developed eleven years after a shot-wound of the head, the bullet passing upward through the roof of the mouth, and finally resting underneath the scalp, where it could be easily felt. Several months after the onset of the Jacksonian epilepsy an operation was done, which uncovered a cyst of the frontal lobe, about the size of a pigeon's egg, and evidently in the track of the bullet. With the evacuation of the cyst and the relief of the pressure the patient eventually made a complete recovery, although there were a few convulsions shortly after the operation.

work in lung resection, which he did some years ago, in which, in one instance, he got a very good result by cutting off the base, first putting a strong suture immediately under the pleura, and drawing it around the vessels and bronchus, then sewing the pleura and lung tissue remaining over the stumps of bronchus and vessels

After the removal of a portion of the lung tissue, we either had to deal with a clean wound or a suppurative condition, if the former, we could feel warranted in closing up the chest cavity and watching developments, whereas in the face of suppuration we should employ drainage from the start

DR LILIENTHAL, in closing, replying to Dr Torek, said he did not leave any piece of lung tissue in this case, as the parts were matted together by adhesions and after the crushing and ligation, the structures of the hilum could not easily recede. He feared the occurrence of a bronchial fistula, but this did not happen. He did not think that in this case the stump could have slipped into the mediastinum on account of the presence of the adhesions, and he did not consider it necessary to leave a piece of lung tissue if the vessels were ligated *en masse*. Dr Carrel had told him personally that his method was to crush and tie off the hilum, and then cauterize the stump with carbolic acid—a method he had adopted after seeing Dr Lilienthal treat the stump of an excised appendix in this manner

The septic and non-septic cases, the speaker said, were entirely different, and required different treatment. In a septic case, drainage of some sort was imperative, while in a perfectly clean case the question arose whether air should be left in the thoracic cavity or whether fluid should be put in. In his own case, he used saline solution. Dr Mackenzie of Portland, Oregon, tried paraffin oil, which, while not an antiseptic, was not a good medium for bacteria.

In the case he had shown, Dr Lilienthal said, it was known that there were adhesions, and differential pressure was not considered necessary. He did not ligate any vessels because the pedicle was a solid mass of inflammatory tissue. He was inclined to agree with Dr Yankauer that early bronchoscopy might help clear up many cases of supposed bronchiectasis of obscure origin. He recalled a case seen at Bellevue Hospital two years ago where there was no history of foreign body, and an operation was contemplated. An X-ray was taken which showed a collar-button in the bronchus. Dr Yankauer removed it with a great deal of difficulty, and the child, after an illness that dated back three months, was well in three days.

NEW YORK SURGICAL SOCIETY

pressure unnecessary that is, we could sometimes get along without it, and personally he had done a resection of the lung lately without resorting to it. The danger mentioned by Dr. Torek, namely, the escape of air into the mediastinum, with fatal results, has often been seen. Yet, in reviewing excision of lobes of the lung for bronchiectasis and tumor, it was surprising that so many patients had recovered. Dr. Meyer said he was, in cases of pneumectomy, in favor of closing the principal part of the wound and then inserting a drain into one corner, or he sutured the entire wound and inserted a drain through a special intercostal incision. Post-operative acute pneumothorax was avoided by keeping the patient under differential pressure for from twelve to fifteen hours. He asked Dr. Lilienthal whether he had first ligated the blood-vessels accompanying the bronchus or crushed them with the latter. In his first case of bronchiectasis operated on by means of pneumectomy where the blood-vessels were tied and divided and then the stump crushed while the patient was kept under positive differential pressure, sudden death occurred. There had evidently been great stress on the right heart by the positive pressure, which besides might have been dispensed with, as there were many adhesions present.

DR. SIDNEY YANKAUER said that in view of the few recoveries that had been reported after resection of the lung, this case was very interesting from a surgical stand-point, but it was also interesting from the bronchoscopic side and the relationship of foreign bodies in the lung to bronchiectasis cavities. In the statistics of such cases, the number in which foreign bodies have been found was negligible, and in his own experience he had found foreign bodies in about one-third of the cases that he had examined.

The case presented by Dr. Lilienthal clearly illustrated what might happen. The parents of this child gave a history of the inhalation of a foreign body, and the general practitioner who saw the case directly afterwards made a diagnosis of laryngeal spasm. Subsequently, diphtheria was suspected, and later Dr. Yankauer succeeded in removing some particles of food from the right bronchus. The case emphasized the importance of early bronchoscopy in every suspicious case of this kind, and, furthermore, he did not hesitate to say that every case of bronchiectasis should be subjected to a bronchoscopic examination at as early a stage as possible.

DR. N. W. GREEN, in connection with the statement made by Dr. Torek that it was very important to crush the bronchus in order to avoid a subsequent emphysema, said he wished to refer to some experimental

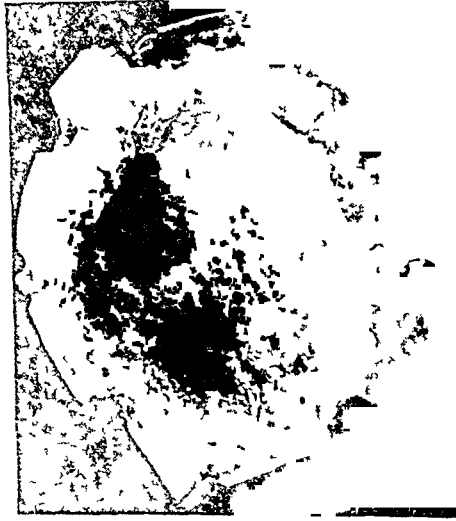


FIG 1 —Mrs A K W Endothelioma of the brain Piece of bone removed from the vertex, $2\frac{1}{2}$ inches by $2\frac{3}{4}$ inches Note the thickness, from 4 to 10 millimetres, also the marked erosion on the inner or cranial surface

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ENDOTHELIOMA OF THE BRAIN THREE YEARS AFTER OPERATION

DR JAMES H KENYON presented a woman, twenty-five years old, a patient of Dr B B Ransom, Jr, of Maplewood, N J, who was referred to Dr. Kenyon by Dr M Allen Starr. She was admitted to the New York Hospital on June 24, 1911, with the history that previous to the onset of her present illness she had always been well and strong. There was no history of any injury to the head. About five years before her admission to the hospital her husband noticed that she was slow in answering questions, and about the same time he observed a small lump on the top of her head, anterior to the vertex. This lump slowly increased in size, the patient's response to questions became more hesitating, she was forgetful and failed to complete her sentences. About four months before her admission she began to suffer from intermittent attacks of severe frontal headache, her vision became impaired, and two weeks later diplopia was noticed. During the three weeks before admission the most marked symptoms were the impaired vision, diplopia and frequent attacks of vomiting.

Examination The patient was fairly well nourished. Over the midline of the vertex in the frontal region there was a hard, non-tender swelling, about an inch and a half in diameter. The overlying skin was normal.

Eyes The pupils were equal and reacted to light. There was double choked disk, no hemorrhages.

The reflexes were equal on both sides, but exaggerated. Sensation normal. The patient was slow to respond to questions, she was listless and did not remember what she did nor what was told her.

Operation, June 26, 1911 Under gas and ether anæsthesia, a crucial incision was made over the swelling on the vertex and the soft parts pushed aside. With the electric motor and the burr drill, nine holes were made in the normal skull about half an inch distant from the swelling. These holes were measured, the three anterior being 10 mm, the others varied from 4 to 9 mm. The circular saw, protected with a washer, was used to cut the bone between the various holes, in two places this cut was across the median line, and therefore crossed the longitudinal sinus. A few light taps with the osteotome cracked the thin, uncut portion of the inner table, and the piece of bone was lifted out.

The swelling revealed by the removal of the bone was over the midline, but somewhat more on the left side than on the right. The ragged surface of the tumor bled quite profusely, but this was readily controlled by firm pressure with gauze thickly impregnated with vasc-

OBSERVATIONS UPON CEREBRAL SURGERY

line. There was no injury to the dura or the sinus from the saw. The longitudinal sinus, which extended along one edge of the swelling, was ligated in two places, about an inch and a quarter apart, and cut. Several large vessels in the dura at the periphery of the mass were ligated. A more or less circular cut was made in the dura around the swelling. As it was decided to do the operation in two stages, the soft parts were sutured in place and a firm dressing applied.

One week later, without anæsthesia, all the sutures were removed and the soft parts opened. With a spoon and small artist's spatula, bent to a curve and heated to a dull red in a Bunsen flame, a large amount of the soft, pulpy mass was removed. The actual cautery and the hot air blast were used to control the hemorrhage. The index finger in the wound could be freely swept in every direction, showing an absence of almost the entire frontal lobe. Vaseline gauze was firmly packed in the cavity and the soft parts partially sutured. A hypodermoclysis was slowly running throughout the entire procedure. The patient was perfectly conscious, she was able to answer questions and did not complain of pain.

The patient made a good convalescence, the temperature never going above 101° , and she was able to leave the hospital twenty-two days after the first operation. Her physical condition was good, but she was very hysterical, talking and laughing, and had various delusions. At the time of her discharge from the hospital the wound showed a large, soft, protruding mass, more or less necrotic. About two months later this swelling had disappeared, and the wound had healed. There was very slight bulging.

Her general condition, physical and mental, rapidly improved, and a month later she was practically well. She had always been fond of music, and was even more appreciative of it after the operation than before. In July, 1914, she apparently showed the effects of over-indulgence in social duties during the previous winter season, and was obliged to leave home for a time for a rest. At the present time, however (October, 1914), she is in excellent condition, both mentally and physically. Her memory is good, and she is free from headache. The area over the vertex from which the bone was removed is firm, with the same curvature as the rest of the head. It pulsates freely.

OBSERVATIONS UPON CEREBRAL SURGERY

DR JAMES H. KENYON read a paper with the above title, for which see page 17.

DR CHARLES A. ELSBERG said that in about 400 craniotomies he

PAPILLOMATOSIS OF THE BLADDER

skull and therefore the exact thickness of bone to be cut was not accurately known

As to concussion, they had found that if the osteotome were held tangentially, as suggested by Dr Lilienthal, the blows produced no effect on the blood-pressure. The sequestration method of anæmia, to which some of the speakers referred, seemed to be a good thing, although he had never used it personally. He was not in favor of hypodermoclysis as a routine measure in these operations, in fact, this was the only case in which he had used it. This was a second-stage operation and the patient was not under the influence of an anæsthetic.

Stated Meeting, held at the New York Academy of Medicine, October 28, 1914

The President, DR FREDERIC KAMMERER, in the Chair

PAPILLOMATOSIS OF THE BLADDER CARCINOMA IN SUPRAPUBIC SCAR

DR EDWIN BEER presented a man, seventy years old, who gave a history of intermittent hæmaturia dating back twenty years. Subsequently pain developed, and in December, 1905, a pedunculated papilloma of the bladder was removed through a transvesical incision. The growth was submitted to Dr F S Mandlebaum, who pronounced it a papillary carcinoma. Within a year he developed a stone in the bladder, of which he was relieved by litholapaxy in November, 1906.

When Dr Beer first saw the patient, in July, 1911, he had extensive papillomatous growths in the bladder which were rapidly reduced in size by various forms of the high frequency current, but the improvement was only temporary, and after a few months' interruption of the treatment the bladder was again filled with numerous papillomata, so that the electrode, when it was introduced, travelled three inches through tumor tissue before it struck the bladder wall. Specimens of these growths were repeatedly removed, and on five different occasions they were submitted to the pathologist and were invariably pronounced simple papilloma.

As the high frequency treatment had proven ineffectual and too tedious, the bladder was re-opened through the old scar in January, 1913, and a large amount of tumor tissue removed. This was also pronounced simple papilloma, without infiltration of the bladder wall.

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had used buirs and fraises in about one-third of the cases. Most of these operations were done a number of years ago, and the dura had been injured at least in a dozen operations. This led him to adopt what he considered a simpler and safer method, the making of drill holes with the ordinary trephine and dividing the flap with cutting forceps. One part of the circumference was always cut obliquely with the Gigli saw, so that when the flap was returned into place it could not rest on the dura. From the time he had used this method he had never injured the dura, and therefore considered the method a very good one. Still the motor and drill is undoubtedly useful in many cases where the skull is very thick and will require great manual labor to cut the bone with forceps. He also believed that the surgeon should use that instrument to which he is accustomed and therefore others might do as well or better with the motor and drill as he had done with the trephine and cutting forceps.

DR LILIENTHAL said he had had the opportunity of seeing the late Dr. Hartley and Dr. Kenyon use these motor drills on the skull, and the work accomplished with this machine was certainly very rapid and beautiful. In certain cases, the saw was of great service, but for decompression purposes he believed that the chisel and gouge, if properly used, were not only the safest but the most satisfactory instruments for opening the skull. By drilling a number of holes first and then cutting with the gouge held tangentially there was no danger of injuring the dura. He had been able to open the skull, do an operation for brain cyst, and close the wound—all in twenty minutes, and as far as speed and safety were concerned, he thought this method compared favorably with any other. The possibility of concussion could be practically disregarded when the gouge was held tangentially.

The value of the sequestration method of producing temporary anæmia could easily be demonstrated by the sphygmomanometer, which showed that it reduced the blood-pressure as much as sixty points. Personally, he resorted to it in all cases in which severe hemorrhage was expected.

DR KENYON, in closing, replying to a question by Dr. William C. Lusk as to whether this instrument, in skilled hands, had ever been known to injure the dura, said he could recall about half a dozen cases where the dura was slightly nicked, perhaps for a distance of one-quarter or one-half inch. He only remembered two instances where the underlying cortex was nicked. In none of these cases did any serious result follow, and they all occurred during his earlier experience with the instrument, when an insufficient number of holes were made in the

NON-ROTATION OF COLON AND ULCER OF STOMACH

PERINEPHRIC ABSCESS, DUE TO STONE IN THE KIDNEY, COMMUNICATING WITH KIDNEY PELVIS

DR BEER presented a woman sixty-three years old, who was admitted to the Mt. Sinai Hospital on September 20, 1914, with the history of dull pain in the left lumbar region dating back for five years, and that for two weeks prior to her admission she had suffered from fever and chills. She gave no urinary symptoms and her temperature was normal.

The case at first was not regarded as of surgical interest, but upon examination a small, fluctuating tumor was located in the left lumbar region, which upon aspiration proved to be an abscess containing pus in which the bacillus proteus was found. The cystoscope showed that the left ureter was obstructed while the right kidney secreted normal urine. An X-ray gave negative findings.

Upon operation, which was done on September 26, 1914, Dr Beer found a superficial abscess leading down to the kidney, which was surrounded by dense, perinephric fat. The kidney pelvis contained numerous stones. The specimen shows the tract leading from the pelvis through the parenchyma.

NON-ROTATION OF THE COLON AND ULCER OF THE STOMACH

DR WILLIAM A. DOWNES presented a man forty years old, who was admitted to the hospital on June 4, 1914, complaining of pain in the upper right abdomen. His past history was that he had typhoid fever at the age of twelve, and that for the past five years he had what he termed attacks of pain in the stomach.

His present illness began seven weeks ago, when he vomited and felt weak and faint. A few hours later he had severe, cramp-like pain in the abdomen, radiating to the back. The vomitus contained no blood. Attacks similar to this one were repeated once or twice weekly and they apparently bore no definite relationship to the taking of food. He had lost 25 pounds in weight.

Examination of the abdomen showed no rigidity, but slight tenderness in the upper right quadrant. At the operation, which was done on June 5, 1914, the stomach was found to be dilated, but normal in location. On the lesser curvature, near the pylorus, there was a dense area of scar tissue, the result of a cicatrizing ulcer, and the entire stomach wall was somewhat thickened. The ascending and descending portions of the colon were adherent to each other. The colon with the omentum lay entirely to the left of the median line; the appendix and cæcum were in the left iliac fossa and the duodenum intraperitoneal.

The operation consisted of an anterior gastro-enterostomy with a

At this time radium was given a trial, but the specimen was not sufficiently powerful and practically gave no result and the bladder was allowed to close

Following this operation there was a rapid recurrence of the vesical growths. The patient suffered much pain, necessitating the use of opiates. His kidneys gradually refused to act and he became oedematous up to the umbilicus. There was great frequency of urination, with excruciating pain, and his condition became so pitiable that on November 29, 1913, Dr Beer did a suprapubic cystotomy and resected the anterior wall of the bladder, to which large tumor masses were adherent. At the same time he tied off some of the smaller growths and cauterized others with the Paquelin cautery, also cauterizing all suspicious areas of the bladder wall¹. After a rather stormy convalescence the patient recovered. Subsequently, three tiny papillomata in the scar in the anterior bladder wall were removed without any difficulty with the high frequency current. The patient was now fairly comfortable and remained so until the summer of 1914, when he developed a nodule in the suprapubic scar. About three weeks ago a section of this was excised and submitted to Dr Mandlebaum, who pronounced it carcinoma. The patient was receiving X-ray treatment at present.

FECAL FISTULA NEW METHOD OF CLOSURE

DR BEER presented a man, sixty years old, in order to illustrate a new and simple method which he had devised for the closure of a fecal fistula. The patient was operated on in October, 1913, when the first stage of the Mikulicz operation for carcinoma of the descending colon and sigmoid flexure was done. Six days later the protruding mass was cut off flush with the skin, and a week after this a remaining spur was crushed.

On September 14, 1914, about a year after the original operation, the following procedure was successfully carried out to close the resulting fecal fistula. The idea underlying the operation is the extraperitoneal closure of the stoma and the immediate covering of the suture line with skin and fat flaps taken from either side of the stoma. By this means if a leakage occurs its tract becomes circuitous and by virtue of that fact it is very liable to close spontaneously.

This procedure can readily be carried out under local anæsthesia and is very evidently much simpler than the usual methods.

¹ The extent of the growths can be best appreciated from the fact that the cautery was used for 40 minutes within the bladder.



FIG 1 —Non-rotation of the colon

loop of about eight inches—a longer loop of intestine was not necessary as the intestine did not have to be carried over the colon and omentum—the anastomosis lay entirely to the right of these structures. The patient made a good recovery and was discharged on June 18, 1914.

DR LEON T LEWALD showed a series of radiographic plates illustrating the abnormal position of the colon in the case presented by Dr Downes (Fig 1). The case illustrated particularly well the necessity of the roentgenologist making a *complete* examination of the gastrointestinal tract in each case referred to him for examination. It had so happened that in this case and in two other cases which Dr LeWald had seen, the Rontgen examination had been *limited* to the stomach, and in all three cases there had been non-rotation of the colon, left-sided situation of the appendix and cæcum, and an abnormal position of the duodenum. In the first case another roentgenologist, Dr L G Cole, had made a diagnosis of a pathological condition of the duodenum requiring surgical intervention. A subsequent examination was made by Dr LeWald, who examined not only the stomach and duodenum *but the colon as well*. Non-rotation was found, and it then became evident that the peculiar appearance of the duodenum was due to the non-rotation of the colon and hence lost its significance as an indication for surgical intervention. In the second case a roentgenological examination of the stomach region alone had been made at another hospital and terminated as soon as a peculiarity of the duodenum was observed. A diagnosis of dilated duodenum was made and the abdomen opened. Non-rotation was recognized and the abdomen closed without further procedure. In the case presented by Dr Downes the examination had *purposely* been limited on account of urgent symptoms of gastric dilatation and retention of the bismuth meal. Enough of the bismuth, however, had gone into the first part of the colon to indicate that there was *apparently* an abnormality of the colon. This fact was incorporated in the record of the Rontgen findings, *but failed to reach* Dr Downes' attention, so that he independently noted the abnormality of the colon on the operating table as he was searching for the jejunum in order to perform a gastrojejunostomy. As he stated, owing to the abnormality, one might easily have seized the terminal loop of the ileum and considered it the first loop of the jejunum, as it presented itself on the *left* side, while there was no true duodenojejunal angle present, as is the rule in these cases, for the duodenum does *not* pass behind the stomach, but is found passing straight out to the right and passes then downward and becomes jejunum without there being any external appearance to indicate the junction. Dr Downes' case is the first case

INTESTINAL OBSTRUCTION DUE TO ILIAC SPASM

in which Dr LeWald had known of a gastro-enterostomy having been performed in a case of non-rotation or transposition of the viscera. In the *complete* transposition cases there would be little chance for error in recognizing any portion of the intestine unless perchance one should encounter a case of transposition complicated by a non-rotation of the colon in the *same* individual. In such a case, the double anomaly would bring the appendix back on the right side and there would be an absence of any part of the colon on the *left* side.

INTESTINAL OBSTRUCTION DUE TO ILIAC SPASM

DR WILLY MEYER presented a boy, nine years old, who was operated on at the German Hospital on January 21, 1914, for acute appendicitis. A gangrenous appendix was found, necessitating drainage. When Dr Meyer subsequently took the service, the wound had almost closed, but the boy's bowels were not moving regularly, and one morning he had a severe attack of abdominal pain, with vomiting, no evacuations. The house surgeon had already given two doses of castor oil, without result, and when Dr Meyer saw the patient he ordered suppositories of aqueous extract of laudanum and extract of belladonna, which he had seen act favorably in these cases. A number of hours later the boy had a thorough evacuation of the bowels. This treatment was repeated several times with success, but when the medication was stopped the symptoms of intestinal obstruction recurred. Peristaltic action of the bowels could be clearly seen and loud gurgling noises heard. As pain and vomiting persisted, a second operation was decided on.

Upon opening the abdomen below the umbilicus, many adhesions and bands were encountered, but none of the latter were of sufficient strength to produce compression of the bowel. The incision was thereupon extended above the umbilicus, and there, at the uppermost portion of the jejunum, was a much distended segment of gut, and tracing this downward they found that it led into a section of intestine, perhaps two feet long, which was in a state of complete collapse. Upon manipulating this it slowly began to fill with air and gradually assumed its normal appearance. The entire gut was then traced down to the cæcum without finding any other abnormality. The abdomen was thereupon closed, and as a possible preventive against further adhesions, Dr Meyer said he adopted the application to the abdomen of superheated air, as recommended by a colleague in Philadelphia not long ago. In this case he used a cradle with a double row of electric lights inside, which was applied to the abdomen over blankets for about six hours, it was then removed for a time and later re-applied, this being done three or four

RESECTION OF THE LUNG FOR BRONCHIECTASIS

the courtesy of Dr. Westbrook the case was referred to Dr. Meyer. On the left posterior chest wall there was a deeply indented scar, and in its depth lung tissue was exposed, with numerous open bronchi at its base. The condition was suggestive of the result of an old embolic septic pneumonia.

Operation. The patient was placed on her abdomen, and under general anaesthesia the wound was re-opened and portions of the fifth, sixth, seventh, eighth and ninth ribs resected, taking pains to leave the infected tissues untouched. The speaker said he entered the remnant of the pleural cavity above and below the open wound, having circumscribed the entire field and entered the pleural cavity the actual cautery was applied and the wound in the lung fully exposed. There were so many adhesions that differential pressure was unnecessary. His desire, Dr. Meyer said, was to extirpate the involved area, but the lower affected pulmonary lobe was so much a unit with the upper that this would have necessitated transverse division of the entire upper lobe, and as the patient's condition was not of the best, it was decided to do a resection. Two clamps were thereupon applied and the entire diseased portion excised. As the lobe was much contracted and somewhat atelectatic, its two sides were unequal and had to be closed separately, ligatures being placed around the bronchi and vessels. An inverted chromicized gut suture was then inserted, as in gastro-enterostomy. This having been done, he had to deal with two remnants of lung tissue closely attached to the bronchi, but separate, and these were stitched together with a running suture.

The patient made a good recovery as far as the first stage of the after-treatment was concerned. But early during the third week she developed a fever, evidently due to a localized pneumonic process. Active pressing gave rise to a slight hissing noise in the wound, showing that all bronchi were not entirely closed. This complication, the speaker thought, might perhaps have been avoided by a more thorough sterilization of the bronchial lumina with pure carbolic or active cautery. There were still three small openings leading down to the infected bronchi, but the patient's general condition had greatly improved since the operation, she had gained over twenty pounds in weight and there was comparatively little expectoration.

Dr. Meyer said he believed that the best treatment for these cases was extirpation, and he would resort to this whenever possible.

DR. WALTON MARTIN asked if this patient had suffered much from cough. It had been his experience that one of the most distressing symptoms was persistent cough as long as the fistula remained open.

times in the course of twenty-four hours at lengthening intervals. Of course, he could not say positively that this prevented the formation of post-operative adhesions, but in this case, at least, the patient's bowels moved soon without assistance. The method had been recommended as a very efficient one for producing early evacuation of the bowels after abdominal section. The speaker said he had used this method in another case to satisfaction and that he expected to continue to use it, as he believed it had some effect to prevent the formation of adhesions.

In this particular case, Dr. Meyer said, the cause of the intestinal obstruction, so far as he had been able to discover, was very unusual. The ileus could not be traced to an actual mechanical obstruction nor could it be termed a paralytic ileus. There was complete collapse of about twenty-four inches of intestine, due likely to a pronounced spasm, upon manipulation the air re-entered this section of gut, which thereupon resumed its normal function. The speaker said that a similar case had come under his observation on a former occasion.

DR. KAMMERER asked Dr. Meyer whether his manipulations possibly might have loosened some adhesions. The empty section of gut was perhaps only an expression of a twist or other mechanical obstruction which was suddenly relieved. Personally, he had never seen a spastic condition of the gut such as that described by Dr. Meyer.

DR. MEYER said that there were, of course, a certain number of adhesions about the cæcum, but nothing like a groove in the gut due to a band that would have accounted for the obstruction. When he came down upon the distended gut in the uppermost part of the intestinal tract, he confidently expected to find a mechanical obstruction lower down, to account for it. But there was nothing of the kind. This boy had typical symptoms of obstruction, with vomiting, pointing to the seat of trouble in the upper intestines.

RESECTION OF THE LUNG FOR BRONCHIECTASIS

DR. WILLY MEYER presented a woman, fifty-seven years old, upon whom he had operated in May, 1914, for bronchiectasis. The speaker thought a clear distinction should be made between an excision of the lung, such as that described by Dr. Lilienthal at the previous meeting of the Society, and a resection of the lung, as was done in this case. This patient was first operated on at a Brooklyn Hospital in January, 1910, for an empyema following acute pneumonia. In the course of the following years Dr. R. W. Westbrook of Brooklyn performed a number of operations, some far reaching, to close the empyema fistula. At last a wide thoracoplasty was done and a lung focus laid open. Through

another surgeon where a prolonged and futile search for the appendix through the anterior incision resulted in the death of the patient. It was better, under such conditions, to abandon the anterior incision without unnecessary delay, turn the patient on his left side with a sand-bag under the hip, and make a second incision posteriorly towards the kidney, when the appendix would usually come into view and could be removed without further trouble.

DR DOWNES said that in the case he had shown at this meeting the ascending and descending limbs of the colon were bound together with a series of very firm adhesions.

DR DELATOUR, in closing, said that in one of the illustrations he had shown, which was taken from Huntington's Anatomy, the cæcum was placed entirely to the left, yet the appendix was to the right. This might give rise to right-sided symptoms with a non-rotated large intestine.

DR. MEYER replied that while this patient still suffered from a few distended and chronically inflamed bronchus divisions, her cough had almost disappeared and the discharge from the fistula had greatly decreased. At the present time she had perhaps three or four fits of coughing in the course of twenty-four hours, with very scant expectoration. There was apparently still a cavity formation in the first division of the bronchus.

PERSISTENT EMBRYONAL TYPE OF LARGE INTESTINE

DR. H. BEECKMAN DELATOUR read a paper with the above title for which see page 74.

DR. LEWALD showed a series of radiographic plates illustrating the type of cases described by Dr. Delatour. Dr. LeWald had observed four cases of non-rotation of the colon roentgenographically and had also personally studied eight cases of complete transposition of the viscera. Therefore a left-sided appendix was possible from either one of these anomalies of development, and was of frequent enough occurrence to keep one always on the lookout for it. The position of the cæcum, and in many cases even the appendix itself, could be definitely determined prior to operation if a complete Röntgen ray examination of the digestive tract were made.

DR. BEER said that in connection with the interesting cases reported by Dr. Delatour he wished to call attention to another type of congenital deformity of the large bowel which he had had an opportunity to see. About nine years ago a three-days-old female child was brought to him with the history that the bowels had not moved. On inserting the finger into the rectum he found an obstruction about two and a half inches from the anus, where the bowel was contracted to such a degree that only a small silver probe could be introduced, even under guidance of the eye through a proctoscope. A laparotomy was done to relieve the obstruction, and he exposed a section of bowel that he supposed was the cæcum. An artificial anus was established, but the child continued to vomit and death occurred. At the autopsy the artificial anus was found to be low down in the ileum, and the entire colon was about the calibre of an adult ureter.

DR. WILLY MEYER referred to cases of non-rotation of the cæcum, to which Dr. Vosburgh called attention about two years ago. In some cases of appendicitis where we failed to locate the appendix through the usual rectus incision he thought it advisable that no time should be lost in abandoning the anterior incision and making an additional posterior incision. He recalled one interval operation in the hands of

BOOK REVIEWS

safest line of treatment The four principal conditions under which operation for appendicitis is done are described as (1) early in the attack when the disease is still confined to the appendix, (2) when abscess is formed but is limited by adhesions, (3) in the presence of general peritonitis or where abscess had recently escaped into the peritoneal cavity, and (4) in the intervals between exacerbations of chronic or recurrent attacks This is a widely inclusive list of indications

Perhaps there is too much medication in this book to suit the modern surgeon Strychnia, ergot, hot coffee, and whiskey in shock are all mentioned Styptic drugs, such as tannic and gallic acids, lead acetate, ergot, hamamelis, hydrastine, and stypticin, are mentioned in connection with hæmophilia, but transfusion of healthy blood is not Cod-liver oil, creosote, guaiacol, arsenic, and syrup of iodide of iron are recommended in tuberculosis Whiskey, strychnia, and quinine are recommended as stimulants in cancrum oris

Before performing arthrectomy, the author says the limb should be "Esmarched"¹ The reviewer has struck what he had hoped were effective blows at the hydraheaded monster, "proper-name nomenclature"; but here it lifts its head again and flaunts itself more viciously than ever before, entwining now in its toils the name of Esmarch, and that honored name no longer a solid thing to conjure with as of yore, but transmuted into a verb—a squirming and inconstant verb—as though to call from his grave the peaceful master to twine himself around a leg and stop a bloody flux Come let us up and at it, lest it return again, and lest we see the urethra otised, the vagina simsed, the female pelvis kellyed, calculi bigelowed, and not only the kinks of the bowels but broken bones as well smoothly and deftly laned out! Surgery has seen some bad business We have sewed up in the abdomen such substantial objects as Pean clamps and Bull retractors—nouns, and bad enough—but pity the unhappy patient with a verb sewed into his insides, to give issue not to peans but rather to persuade him that his belly harbors a bull in a china shop

The book was never written that could please all humors. This book of Dr Kelly's should be gratefully received by the surgical world It is surgically sound, and constitutes a much needed contribution to the literature of surgery The surgeon who studies it will, in so doing, qualify himself just so much better to administer to that class of patients most needful of careful treatment It is capable of making him more competent as the conservator of the child

J. P. WAREASSE

BOOK REVIEWS

SURGICAL DISEASES OF CHILDREN By SAMUEL W KELLY, M D,
LL D, Pædiatrist and Orthopædist, St Luke's Hospital, Cleveland
Second Edition E B Treat Company, New York, 1914

This book, dedicated "to any hapless child, crippled, injured, ill, and to any doctor who sees and fain would help," is decidedly something more than a general surgery as applied to childhood. It actually deals with the peculiar physiological and pathological conditions which have to do with surgical diseases in children, and coordinates them with such surgical treatment as is applicable to the child. Besides its scientific quality, the book possesses the rare human appeal which the suffering child calls for.

Surgery has been written with the mind largely upon the adult patient. This book is different. The adult is considered only in the light of what he can do for the child, and in the light of the fact that "the child is father to the man." "With infants and young children a certain amount of 'mothering' seems to be a necessity. Without it they become apathetic and give up the fight for life." The author furthermore says, "An abundance of fresh air and sunlight should be provided. Because children's beds are small is no reason why more of them should be crowded into a ward. Too many people think any little corner will do for the child's bed. There is no class of patients who so promptly fade and languish when deprived of air and sunlight, and none will respond so quickly to their health-giving influence."

In discussing the treatment of tuberculous disease, inconsiderate surgical interference is interdicted, but when operation is determined upon, it is urged that it should be done with the most scrupulous thoroughness. Treatment in tuberculosis, it is shown, is much more conservative than it formerly was, but, when surgical interference is inaugurated, it is much more radical than formerly. Half-way measures are to be avoided, when operation is determined upon it should be complete.

The cerebrocranial topography, it is shown, is quite different from that in the adult. The fact that every surgeon knows how to put on a good plaster jacket, yet not every surgeon puts on a good plaster jacket, is brought out.

In appendicitis it is urged that early operation in all cases is the

Though the modern operative treatment of acromegaly and other hypophysis diseases is now well recognized and offers some success, the author merely states that attempts at operation on the pituitary body have been made. A similar omission is again manifest in the treatment of spastic paralysis conditions. No reference is made to the recent operative work on the resection of the posterior spinal nerve-roots. A criticism that is perhaps more to the point concerns the very brief mention made of surgical methods of examination. In a volume designed particularly for student purposes, an enumeration and description of bedside methods is certainly of considerable importance.

Where there is any radical difference of opinion amongst surgeons regarding the proper treatment of a given disease, mention is usually made to this effect and the views are briefly enumerated. The author's discussion of such a common disease as appendicitis is excellent and should prove very helpful to the student. He prefers to remove the appendix as soon as the diagnosis is established, rarely waiting for other features to develop.

In the field of gynæcology several important conditions are omitted. No reference is made to such common disorders as carcinoma of the uterus and perineal lacerations. It is manifestly impossible to make a text of this nature cover all the diseases of surgery and the provinces associated with it. Nevertheless, a consideration of the commoner surgical ailments is undoubtedly more valuable to the beginner than a reference to curiosities and laboratory tests.

A commendable feature of the discussion on cranial tumors is the emphasis laid on preventing blindness. With most neurologists the author encourages early operative interference.

The criticism mentioned above, regarding the failure to record certain recent operative therapy, is noted again in the discussion of Pott's disease. Calot's jacket treatment, which is probably the best therapy suggested thus far, receives no mention. Though the new plastic operation of Albee is still in the experimental stage, it seems as though it warrants a reference.

In reviewing the work one feature particularly attracts the attention of the reader—an absence of any references to the current literature. While this holds true for some of our standard text-books, it nevertheless seems inexcusable in a work designed chiefly for the instruction of the growing generation of surgeons. The undeniable benefits accruing from the references included in texts used during undergraduate years makes this an important feature.

While the illustrations are not of the best workmanship they are

BOOK REVIEWS

THE PRACTICE OF SURGERY. By RUSSELL HOWARD, Surgeon, Poplar Hospital, Assistant Surgeon, London Hospital, Joint Lecturer on Surgery, and Teacher of Operative Surgery, London Hospital Medical School 1227 pages, 8 colored plates and 523 illustrations in the text J B Lippincott Company, Philadelphia Edward Arnold, London, 1914.

This volume was written at the request of many past and present students of the London Hospital The author has endeavored, as far as is possible in a text-book, to convey the surgical teaching of this medical school

The book embraces thirty-seven chapters It covers nearly the entire field of surgery, including brief accounts of the work of the orthopædic, the genito-urinary and the neurologic surgeons, the gynaecologist, otologist, and the laryngologist The book, accordingly, is comprehensive and affords an introduction into the rarer abnormalities and to curiosities as well as to the commoner diseases of surgery Unsettled points of theory and practice are not discussed, though they are given appropriate mention

No attempt has been made to take up surgical diseases in their order of interest, importance or frequency From the didactic standpoint this is the weakest point in the work, as an equal emphasis is laid on each province and the student derives no definite hitching posts to assist his memory The order of presentation of subjects corresponds to the classical method of first stating the principles of surgery and then discussing the various organs and systems in turn

The book opens with a review of our present knowledge regarding infection, immunity and serum therapy In view of the demands of our modern medical curriculum, this section seems out of place in a text-book of surgery, notwithstanding past traditions The brevity of the section, furthermore, emphasizes its uselessness A chapter on inflammation follows The principles and methods of treatment referred to here are very good and correspond to the general excellence of the therapeutic advice offered throughout the work

As the volume has been designed chiefly for undergraduate use, no attempt is made to detail operative technic The appropriate operations are mentioned throughout, however, and usually sufficient description is included under each to afford the reader a fair idea of the steps taken To the beginner the emphasis laid on asepsis in each section is of some importance This should aid materially in the adoption of proper operating-room methods in post-graduate years

BOOK REVIEWS

ANOCI-ASSOCIATION. By GEORGE W CRILE, M D, AND WM E LOWER, M.D, Cleveland W B Saunders Co, 1914

This volume of 250 pages by Crile and Lower will be welcomed by every physician. Part I contains a statement of the kinetic theory of shock and the principle of anoci-association. Part II contains a statement of the application of the kinetic theory to the technic of surgical operations.

The introductory chapter should be read, as it states the several steps which Crile and Lower followed in pursuit of the causes, manifestations and treatment of surgical shock. According to the kinetic theory of shock the exclusion of both traumatic and emotional stimuli will wholly prevent the shock of surgical operations. In this book are grouped the several factors which make for operative safety. The authors have attempted to show the importance of these various factors.

However we may feel regarding the practical application of all the procedures advocated as necessary in order to prevent shock at surgical operations, this book impresses one as a valuable contribution from the laboratory and the clinic to practical surgery. In this monograph keen observers have linked the returns from the experimental laboratory and the hospital clinic and have given to the operating surgeon facts of inestimable value for safer surgery. The chapter upon the technic of administering oxygen anaesthesia is a valuable one. In the appendix of the book are stated the relations of anoci-association to the pre-operative and post-operative care of patients.

I believe that the practical application of anoci-association in a large general hospital service is attended with many difficulties. I believe that in a few selected cases it is of very great value in its completed form. I believe that surgery to-day is greatly indebted to Crile and Lower for the results of this experimental work. Surgery has been made safer because of these researches. The principle of anoci-association has been placed upon a firm basis and this achievement is a contribution to surgery of very great value. The importance of the work of Crile and Lower lies in the fact that they have succeeded in correlating the various factors which enter into the principles of anoci-association. They have grouped together the many factors and have shown the relations of these factors one to the other and to the general principle of anoci-association. Herein lies the great value of this contribution to surgery. The book should be read by every medical man, physician and surgeon alike.

CHARLES SCUDDER.

BOOK REVIEWS

practically all new and, accordingly, are refreshing. The greater number are clear and significant. Only a very few are devoted to the illustration of steps and methods in operative technic.

The style is attractive and the English terse and to the point. The argument is followed throughout with but little difficulty. For students particularly this new volume should prove very useful.

ERNEST G. GREY

A SYSTEM OF SURGERY. Edited by C. C. CHOYCE, B.Sc., M.D., F.R.C.S. AND J. MARTIN BEATTIE, M.A., M.D., C.M. Volume III, text 874 pages, illustrations 242. Publishers: Funk, Wagnalls Co., N.Y.

This third volume of Choyce's system of surgery completes the work by considering the following subject matter: cardiovascular, lymphatic, respiratory and muscular systems, neck, ear, nose and throat, bones, joints and deformities, with a general index of the entire three volumes of the system.

In common with the first two volumes the reviewer notes the clear-cut comprehensive style of the text, the more than usual space devoted to surgical pathology as an introduction to each chapter and subject and the useful bibliography that closes the same.

The anatomical, physiological and pathological point of view is so well established that what follows of text becomes a natural surgical sequence and not an isolated statement of fact. A chapter entitled "Lymphatic Invasion of Cancer" and another on the correlation of cerebrospinal physiology and the symptomatology of its surgical diseases illustrate this point of view to the great profit of any reader.

The chapter on bursæ is a monograph. Those on the diseases of the osseous system and joints by the editor occupy 234 pages of well-arranged text and well-selected, not overcrowding illustrations.

Those factors in bone anatomy, histology and osteogenesis that have so important a bearing on the proper surgical conception of bone disease have been given notably careful consideration.

As in the first and second volumes, operative technic is dealt with suggestively, leaving space for the study of the basic principles of surgery and avoiding the usual presentation of many discarded and antiquated operative procedures.

Again the reviewer commends this work as a broad general treatise, with a thoroughly scientific point of view, expressed by men well known in their fields of work, and compiled in such a manner as to justify publication and study.

WM. C. WOOLSEY.

almost inky blackness appears at this spot, and we are thus aware that the glove must be changed. The explanation is that salicylic acid strikes with the iron which is such a prominent ingredient of the blood a deep purple, the iron salicylate in some lights looking almost black.

Now, why is the "cream" sometimes—quite often—pink or purplish in color? The answer is that hardly a specimen of either alum sulphate or of sodium carbonate is free from at least a trace of iron. Iron, in some cases as a soluble, in others an insoluble impurity, is the most widely prevalent chemical known, and traces of it are almost invariably found in all heavy chemicals. The best-known re-agent for the detection of this trace is acid salicylic or a salicylate—the addition of which will produce immediately a color varying from the faintest pink tinge to a deep purple, according to the amount of iron present.

A few further points I would like to mention. It is noticeable, after the longest operation, if the gloves are proper in point of size and do not constrict the fingers, that if anything the sensibility seems rather increased than lessened. Of course the various dry lubricants must have the opposite tendency. Again, the reason why so large a proportionate amount of washing soda is used is that with less there is a degree of acidity which, though trifling, may annoy some skins, conceivably. It is surprising, unless one has tested the point, how very acid is alum sulphate.

Finally, a point by no means to be ignored, is the query—Is this lubricant an irritant to any serious degree, if brought in contact accidentally with the wound surface? The reply, based upon experiment, is in the negative. Perhaps as striking an evidence of this as could be adduced is the one which follows.

During my active professorship in the Polyclinic Medical School, upon one occasion I was asked to operate upon a case of acute appendicitis. As it was not my clinic day I borrowed instruments and assistants and set to work. With the wound fully made, but as yet not penetrating the peritoneum, an assistant allowed a four-hooked, sharp-pointed retractor to slip, and it tore one of my gloves from Dan to Beersheba. At once the wound was, for most of its extent, smeared with the alum cream from within that torn glove! As the assistants were removing it as well as they could by flushing with sterile warm water, I called Prof. Wyeth's attention to the accident, asking him to bear witness as to the ultimate outcome. The stain would by no means all come away. The very dark salicylate of iron was fixed in the blood of the exposed tissues. However, the case resulted in healing under primary union, quite as if nothing untoward had happened.

CORRESPONDENCE

ALUM CREAM

THE IDEAL RUBBER GLOVE LUBRICANT

For at least ten years past the writer has been regularly in the habit of using alum cream, and his various staffs of assistants have done so, too, during this time. It has proven so satisfactory and fulfils so many different functions besides lubrication that surely it deserves to become more widely known.

In appearance its name of cream is sufficiently accurate. Sometimes, however, for a reason to be subsequently explained, it is distinctly pink or purplish. This is without any importance as to its effects, in usage. Its formula is as follows:

Take

Sodium Carbonate	5 i
Aluminum Sulphate	5 iv 3 ii
Tragacanth	3 ii
Ac Salicylic	9 ii
Glycerine	3 iss
Alcohol	3 vi
Water	5 iv 3 ii

The compounding is done as follows. Take the sodium carb, alum sulph, tragacanth, mix, then add the hot water and glycerine and rub well together until a smooth paste results, then add ac salicylic, dissolved in alcohol. Again triturate well together. Let it stand one hour, then add enough water to make 5 viii.

The aluminum sulph is not only a well-known antiseptic, but also a powerful astringent. It promptly prevents any sweating within the glove, and if the hands are first thoroughly cleansed mechanically, using this alum cream freely is all that is necessary to accomplish thorough antiseptics within five minutes following.

The ac salicylic has three functions in the cream. (1) It is one of our best-known antiseptics, (2) it counteracts the tanning and hardening tendency of the alum salt, as we all know, ac salicylic is our best-known softening agent upon the skin, and (3) through its presence in the cream it becomes, so far as known, *our only tell-tale lubricant*. If a glove is punctured even to the extent of a drop of blood admitted from without or escaping from a punctured finger-tip within, and thus coming into contact with the lubricant, at once the fact is known because an

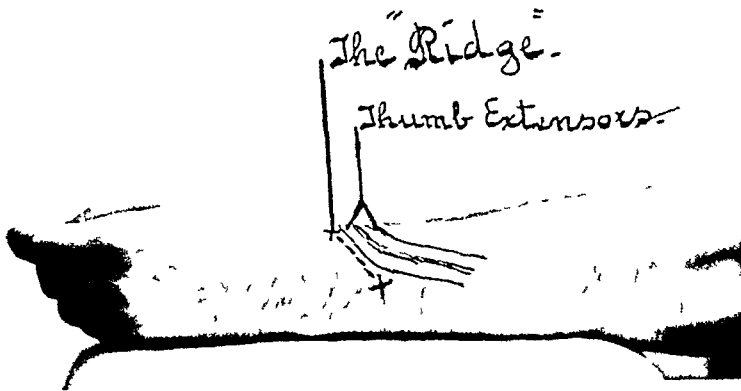


FIG 1 —The oblique extensor radial ridge



FIG 1 —Gross appearance of myxoma of breast, after removal and hardening in formalin.



FIG 2 —Photomicrograph of section through tumor, low power. From below upward observe normal breast tissue, fibrous cellular tissue of tumor, of capsule, and this tissue of the tumor proper.

CORRESPONDENCE

To turn for a few moments to the better known methods of lubrication of gloves—I think it safe to say that in New York in by far a majority of cases either baked starch or baked talcum powder is the substance employed. Either of these is, however, an obvious tactical error, for both, being insoluble in water or in blood-serum, in event of a torn glove would be like so much sterilized buck-dust deposited in the tissues, a mechanical irritant. If one must use a dry powder and cannot see the sundry advantages of alum cream, at least by employing baked boric acid, itself a mild antiseptic, a smooth lubricant and soluble in the blood-stream, he would thereby have a logical reason to give—in contrast with those who prefer talcum or starch.

New York City

ROBERT H. M. DAWBARN, M.D.

THE OBLIQUE EXTENSOR RADIAL RIDGE

BEGINNING near the posterior-external border of the radius, just above its expansion, running upward and inward across its posterior surface just below the tendon of the extensor brevis pollicis, is an oblique ridge which attaches the sheath of the thumb extensors.

In skeletons whose muscular development was scant it is often imperceptible, though it shows faintly in well-developed skeletons. In the vast majority of living subjects it is clearly palpable.

While palpating this region for suspected fracture of the radius one may easily mistake this ridge for the posterior, upper edge of the lower fragment of an obliquely fractured radius, and its importance in this connection seems to warrant calling the attention of fracture surgeons to it.

Syracuse, N. Y.

HERBERT GIFFORD, M.D.

REPORT OF A CASE OF PURE MYXOMA OF THE BREAST

Patient Mrs. E. B., aged thirty-three, mother of three children, youngest eight years of age. Deliveries and lactations normal.

Complaint Tumor in left breast, duration 2 years. No pain or discharge from the nipple. No lumps in other breast.

S. P. Examination reveals small tumor about 5 cm. in diameter in outer half of left breast. It is freely movable under the skin. It is not tender on palpation. Except for this tumor, this breast and the other are normal. There are no palpable glands in either axilla.

Operation Removal of tumor under local anæsthesia, April 12, 1912. The wound healed without complication.

Result (July, 1914) Patient well, no other lumps in the breast.

CORRESPONDENCE

She complains of a stinging sensation in the left breast when she gets warm from exertion. There is no pain in the scar. The tumor was examined by Dr. Bloodgood, whose report, with photographs, is as follows:

Gross pathology. Fig. 1, photograph of formalin specimen. This shows an encapsulated tumor with a narrow zone of normal breast tissue above. In the photograph one can see the breast tissue opaque white, the capsule of the tumor, and the tumor.

Microscopic note. Fig. 2, photomicrograph, low power. From below upward this section shows the breast tissue, the fibrous cellular tissue of the capsule of the tumor, and the tumor. Fig. 3, high-power photomicrograph. Myxomatous tumor tissue about two blood-vessels. In this portion of the tumor there are but a few scattered staining cells. Fig. 4, high-power photomicrograph. Tumor tissue and blood-vessels more cellular.

Throughout the tumor I was unable to find any evidence of the parenchyma of the breast. This is the first case of pure myxoma among 1400 breast tumors.

It is a pleasure to acknowledge the assistance of Dr. Bloodgood in reporting this case. The photographs are by Mr. Schapiro of his laboratory.

Greenville, S. C.

GEORGE T. TYLER, M. D.

CALCIFIED FIBRO-ADENOMA OF BREAST

THE following case history is of interest chiefly because of its rarity. It seems unique, as I have not been able to find its parallel in the literature.

Mrs. J. D. McF., aged forty, married. Robust woman, weighing 189 pounds. Family history, ideal. Has had five children, youngest two years old. Confinements and lactation normal. No previous illnesses. At the age of fifteen years, while breasts were developing, sustained an injury to right breast by being stepped upon by her brother in play. She experienced much pain at that time, and later consulted a physician because of induration and tumefaction of the breast. The induration never entirely disappeared, though until recently it has attracted no special attention. For the past three months the breast has enlarged perceptibly, and has become sensitive to pressure.

Physical examination shows both breasts to be a little over medium size, and well maintained. The right breast is perceptibly enlarged and uniformly rounded. The skin is normal in appearance and the nipple is unchanged. The mass alluded to lies in the upper inner segment. It is very hard and irregular in outline. Slight pressure elicits acute



FIG 3 —Myxoma of breast High power photomicrograph myxomatous tissue about two blood vessels

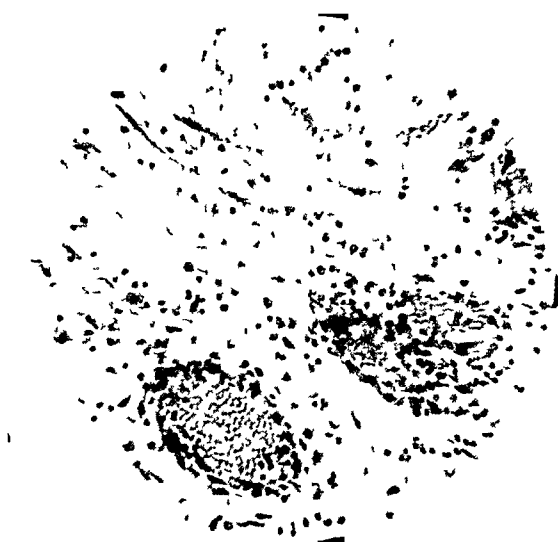


FIG 4 —High-power photomicrograph tumor tissue and blood-vessels

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CANCELLOUS BONE LESIONS *

NON-TUBERCULOUS, NON-SYPHILITIC, NON-SUPPURATIVE, NON-MALIGNANT

BY GEORGE BARRIE, M D

OF NEW YORK

EXCLUDING from consideration the disease termed "infantile rickets," the intra-osseous lesions of the long bones coming under the observation of the surgeon that are distinctly non-syphilitic, non-tuberculous, non-malignant and non-suppurative have been generally regarded as of infrequent occurrence

The writer reports a series of 20 cases of cancellous bone involvement, that, so far as it has been possible to ascertain, cannot be classified with any of the above-named processes

Neither can the cases herein reported as systemic lesions, in the present state of our knowledge, be grouped with the diseases of bone whose etiology is known to be due to disturbed metabolism through the ductless glands

During the past three years the writer has been able to collect a number of these very interesting bone lesions requiring surgical relief and attention, and owes many thanks to his chief and co-workers on the surgical staff of the New York Hospital for Ruptured and Crippled for their encouragement, material aid, and good-will, in referring to him many of the patients observed

The cases presented are readily divisible into three separate groups of cancellous bone lesions as follows

Group 1. Metaplastic osteomalacia—systemic lesions

Group 2 Hemorrhagic osteomyelitis—local lesions.

Group 3. Osteochondrofibroma—congenital tumor

To Group 1 belong the multiple lesions in the long bones that have been so well described by F von Recklinghausen in his very complete work covering the subject published in 1910

Under the subtitle "metaplastic malacia" he decides that *ostitis deformans* (Paget) and *ostitis fibrosa* (von Recklinghausen) belong in this more general term for these systemic bone pathologic changes

Histo- and chemicopathological investigations have failed thus far to

* Read Before the section in Surgery, New York Academy of Medicine, January 8, 1915

CORRESPONDENCE

tenderness The overlying skin, while not attached, is not as freely movable as other areas

The breast, generally, presents a porky consistency, but it is not attached to the underlying muscle No lymph-nodes are present in axilla or elsewhere The very notable hardness and tenderness of the tumor prompted removal of the entire gland, which was done on August 28, 1913

On incising the gland, there was disclosed a gray-colored mass, about the size of an English walnut This was composed of a thick capsule, distended by a well-formed, irregular concretion, about the size of an ordinary olive The mass within the capsule was unyielding and its general appearance was that of a calculus Convalescence was brief and the patient remains well up to the present time

Dr Ophuls, of the Pathological Laboratory of Stanford University, reports as to the pathological findings upon examination of this mass

"In mammary tissue is a hard, calcified, well-circumscribed tumor, 3 by 5 centimetres in diameter Sections show that tumor consists of dense fibrous tissue which is entirely necrotic Large irregular calcified areas In the fibrous tissue were found narrow open spaces without epithelial lining The breast tissue shows marked cellular infiltration, hyperplasia of the glands, some of which are filled with fatty material Nothing suggestive of malignancy Diagnosis Fibro-adenoma of breast (calcified chronic mastitis)"

The ultimate causative factor, in this case, is a matter of some interest Recognizing the fact that a tumor was present from the date of injury, which never entirely disappeared, it seems probable that the early lesion can be identified as a hæmatoma, and later as a hemorrhagic cyst, which, finally, underwent calcification

Its immediate importance is found in the fact that a very definite irritation, of recent date, was manifest, suggesting the possibility of malignancy at a later period

San Francisco, Cal

THOMAS W HUNTINGTON

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ANNALS of SURGERY

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CANCELLOUS BONE LESIONS

It was this macroscopic and microscopic picture of fibrosis that caused him to describe the lesion as *ostitis fibrosa* in his *festschrift* published in 1891. Inasmuch as we have no definite proof that the lesion is an inflammatory process the more recent term seems to better describe the disease.

An intelligent understanding of the pathologic phenomena taking place in these lesions is necessary to the surgeon, inasmuch as he is called upon to give surgical aid in correcting deformities and pathological fractures that the diseased process gives rise to

The routine use of the X-ray has been of great value to the surgeon in throwing much light upon and demonstrating the presence of many cancellous bone lesions that give only trivial clinical symptoms of their presence

In our work covering this field of bone lesions we have procured skiagraphs of the entire skeleton in all cases in which there was a suspicion that more than a single focus existed

GROUP I METAPLASTIC OSTIOMALACIA—SYSTEMIC LESIONS

CASE I—In the first case of this series the blood pictures taken on several occasions have shown a practically normal red cell and differential leucocyte count, hæmoglobin and color index slightly below. In the last differential count an absence of eosinophiles was noted

Several urinary examinations (24-hour specimens) were negative for Bence-Jones bodies

Two recent Wassermann tests were negative. Pain has never been a symptom

The patient has never been incapacitated apart from the period given over to treatment for osteotomy and recovery from pathological fractures

X-rays of the entire skeleton have been made, and no bone involvement found above the pelvis. Size of the skull is normal.

The further history is as follows. Maurice C., male, white, age twelve years, normal height and weight. Healthy looking. Family history negative. Measles when 3 years old. No other illnesses

When 5 years old tripped and fell over a stone, while running, resulting in fracture of the left femur (lower third). Later union with marked knock-knee deformity

At the age of seven years had another fall, again causing fracture at site of former injury, union resulting with about the same degree of deformity that previously obtained.

One year later (child eight years old) osteotomy was per-

lift the veil of obscurity under which the true etiology of the systemic lesions (coming under Group 1) remain hidden

Chemicopathologic research has shown that there takes place an abstraction of the inorganic salts from the involved bone structure—so-called halisteresis—and its replacement with osteoid tissue According to Wells (*Chem Path*, 2nd Ed, p 404) the effect of this is to lessen the weight of the bone 20 per cent to 40 per cent

McCrudden (*Arch Int Med*, March, 1910) found, in the bones of human osteomalacia, that together with a decrease in calcium there is an increase in magnesium and sulphur because of newly-deposited tissue poor in calcium It has been suggested that an acid or insufficient alkaline content in the blood is perhaps a factor in dissolving the salts

Feeding patients with calcium and phosphates has no effect on the disturbed metabolic process In cases of osteomalacia it has been frequently observed that excess of calcium is given off in the urine, and much larger quantities are found in the fæces.

The rôle played by the secretions of the thyroid, thymus, hypophysis, ovaries, testicles, pancreas or spleen have thus far failed to illumine our knowledge as to whether or not any particular gland or group of them is responsible for the pathologic process found in bone described as osteomalacia. For a long time the ovary had the distinction of being considered the offending organ causing the adult type of the disease in the female, and cases are reported of cure following oophorectomy

Further research and investigation is needed from a chemiophysiology and chemicopathologic stand-point, of the function of the bone-marrow as a contributing factor

It is stated (Wells, *Chem Path*, 2nd Ed, p 404) that senile osteoporosis differs chiefly from osteomalacia in that in the former condition no new osteoid tissue is formed

McCrudden (*Arch Int Med*, March, 1912) in his paper on osteomalacia summarizes as follows "The applications of chemical methods have led to the conclusion that bony tissue like other tissue is continuously being destroyed and replaced by new, and that osteomalacia is due to a disturbance of balance whereby the new tissue is poor in lime salts and therefore soft" The starting point in these lesions is caused by an increased catabolism of bony structure due to the need of calcium salts elsewhere Increasing destructive metamorphosis leads to a bending of the bones

In the systemic disease of bone termed metaplastic malacia by von Recklinghausen the spongy structure is converted into, or replaced by, fibrous tissue with or without naked eye cystic areas

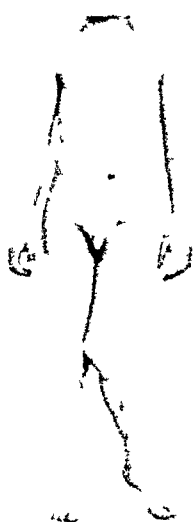


FIG. 1—Case I. Metaplastic osteomalacia, juvenile type. Photographs showing marked left knee deformity due to bone softening.

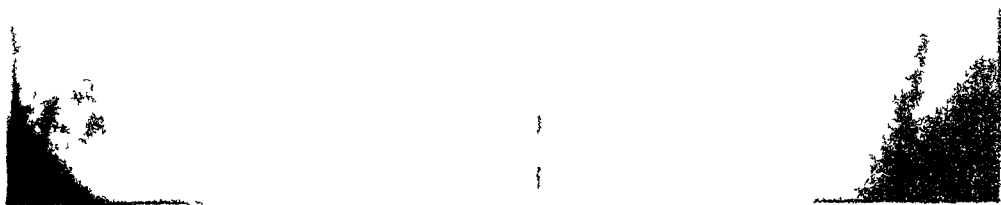


FIG. 2—Case I. X-ray of the knee joint showing severe bone softening and deformity.

formed for correction of left knock-knee Plaster-of-Paris dressings applied for several weeks, after which a raised shoe was worn to overcome shortening of limb

Gave up wearing high shoe one year ago, and now presents himself for treatment of recurrent left knock-knee deformity which greatly interferes with locomotion (Fig 1)

Measurements are as follows Ra, 28 inches, La, $25\frac{3}{4}$ inches Tibiæ of equal length

X-rays (Figs 2, 3 and 4) show marked destructive disease of left pelvic bones and entire length of the left femur The left tibia is apparently normal, left fibula shows involvement in the diseased process

The right ilium and right femur do not give evidence of any active destructive process being present, neither do they give (in the opinion of the writer) the clear-cut picture of normal bone, the right ilium and upper end of right femur present a somewhat hypertrophied, boggy appearance

All of the bones above the pelvis of this patient are negative in so far as the X-ray is diagnostic of disease

June, 1914 Osteotomy for correction of left knock-knee deformity Supporting brace to be applied later Organs and chemiotherapeutic and special dietary regimen to be tested and observations carefully noted and reported later This patient is now in charge of Dr W Frieder of this city to whom I am indebted for the records in the case

CASE II—Francis L, male, white, age six years Family history negative No tonsillar or other infectious diseases No history of injury Has been limping, tripping and falling for last two months Has never complained of tenderness, soreness or pain in either limb Does not have night cries Examinations of hip-, knee- and foot-joints absolutely negative Child has weak feet for which correction shoes are prescribed

Returned three months later for further treatment—there is no improvement in gait

An X-ray (Fig 5) taken at this time shows enlargement and slight coxa vara of the left femur Applications of spica plaster-of-Paris dressing applied Wassermann taken and negative report made, in spite of which antileptic therapeutic treatment was persisted in for 6 months Nine months later another X-ray (Fig 6) was taken which shows further progressive destruction of the upper end of the left femur, beginning disease of the neck and trochanteric region of the right and double coxa vara Another Wassermann taken proved to be negative, several graduated doses of tuberculin were given, with negative results

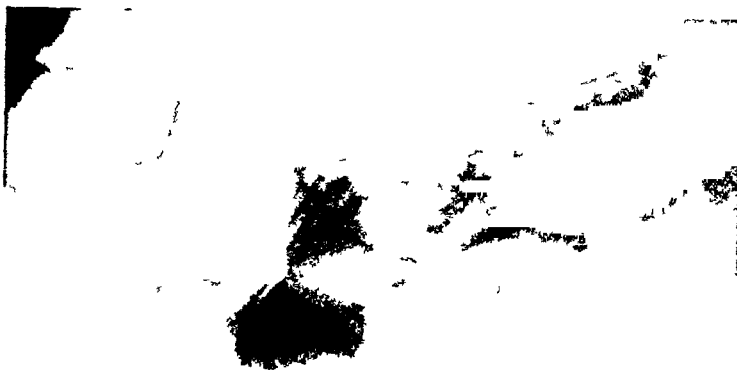


FIG 3 —Case I X-ray shows the same process occupying the middle and lower thirds of left femur



FIG 4 —Case I X-ray showing lesions in upper and lower ends of left fibula

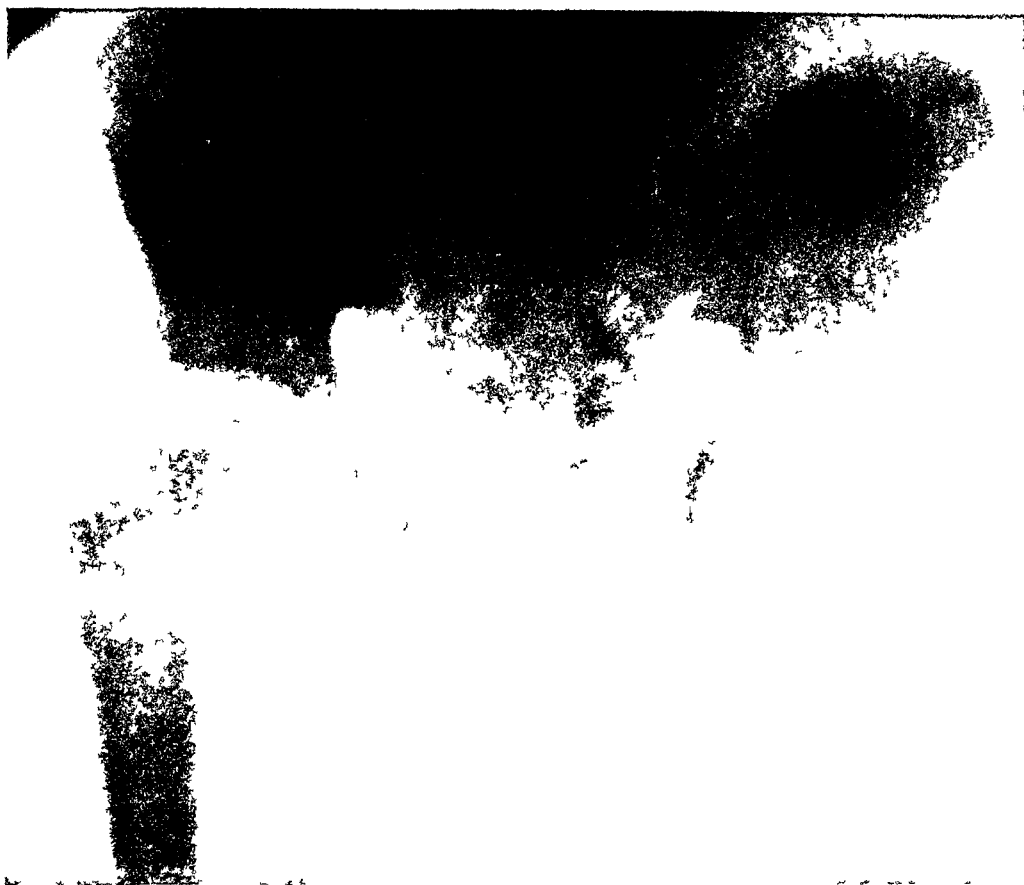


FIG. 5—Case II. Metaplastic osteosarcoma juvenile type. No hyperostosis. A large, dark, irregular and irregular contour of neck and trochanteric region of left femur (C. A. 1934, p. 101) due to softening. Right femur normal.





FIG 7 —Case III Metaplastic osteomalacia adult type X-ray showing displacement, distortion of contour, and disease of upper end of right femur

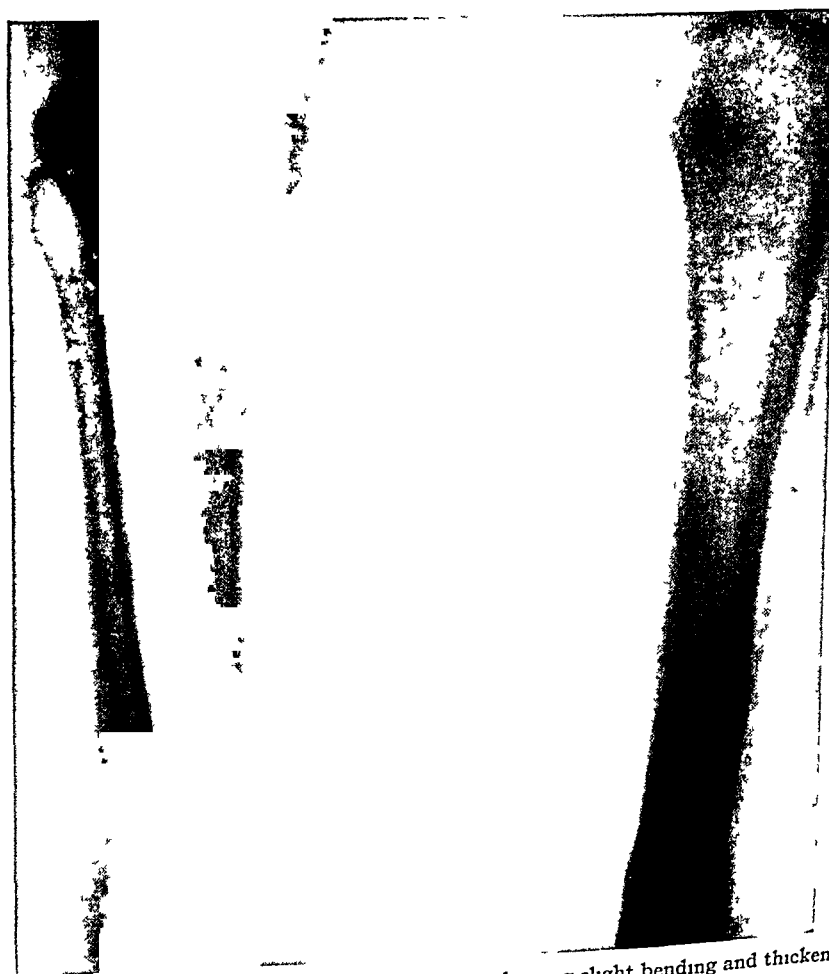


FIG 8 —Case III X-rays of tibiae of same patient showing slight bending and thickening.

CANCELLOUS BONE LESIONS

This case is still under the care and in charge of Dr. W. Frieder to whom I am under obligations for the record and X-ray plates. Clinical and X-ray diagnosis: Metaplastic osteomalacia, juvenile type.

CASE III—Kate G., female, white, foreign birth, age forty-nine years. Multipara. No miscarriages. Last child born 15 years ago. For about 10 years has noticed that right leg seemed to be shorter than left. No history of injury. Has never had any discomfort or pain in right hip. Comes for treatment for relief of pain in her lumbar region which has been more or less constant for 5 years.

Examination shows flexion deformity of 40 degrees, adduction of 20 degrees and shortening of right limb.

X-ray (Fig. 7) exhibits pronounced hypertrophic distortion, obliteration of contour of normal lines, and displacement of upper end of the right femur.

Wassermann negative.

The X-ray (Fig. 8) shown here of the tibiae of this patient if regarded independently might suggest a leucic process. Negative clinical signs, history, and Wassermann reaction rule this out. Skull normal, all other bones give a negative X-ray picture.

Clinical and X-ray diagnosis: Metaplastic osteomalacia, adult type.

GROUP 2. HEMORRHAGIC OSTEOMYELITIS—LOCAL LESIONS

Group 2 comprises those solitary cancellous bone lesions to which the writer has given the term hemorrhagic osteomyelitis.

These localized inflammatory processes occur most commonly in or near the ends of the long bones. When through operative interference the lesions are exposed—and depending upon the stage of reaction present—one of two general clearly defined forms are exhibited, namely, the hemorrhagic granulation tissue (solid) lesion or the fibrocystic or wholly cystic lesion.

The etiology apparently is primarily due to trauma, causing localized destruction of bone trabeculae, dilatation and varicosity of blood-vessels, hemorrhagic effusion, nutritional inhibition and, further, more or less symmetrical bone trabeculae destruction from local pressure necrosis. Efforts at regeneration begin by the formation of young hemorrhagic granulation tissue. Inability of the host to restore architectural arrangement and function results in lesions that may properly be termed localized hemorrhagic osteomyelitis.

Lacking sufficient stimulus, with consequent absence of fibrin, the lesion retains throughout its course the primitive hemorrhagic granu-

lation tissue picture, the process of métaplasia being practically absent. In this form of osteomyelitis the diagnosis is quite generally incorrectly made of medullary giant-cell sarcoma, myeloma, medullary giant-cell tumor, etc.

The writer in papers recently published (*ANNALS OF SURGERY*, February, 1913, and *Surgery, Gynecology and Obstetrics*, July, 1914) has discussed the place the giant-cells occupy in this inflammatory process. A more active stimulant reaction with increased fibrin production causes local metaplasia and converts the hemorrhagic granulation tissue into fibrous structure with consequent retraction and cyst formation. This advanced form or stage of the initial lesions gives an operative picture of a localized fibrocystic osteomyelitis.

The writer is of the opinion that in some instances the stimulant reaction is active enough to prevent further tissue destruction, to absorb all débris, and to form a more or less dense bony wall around the cavity that nature's efforts have failed to obliterate. The solitary bone lesions usually classified as benign bone cyst, osteitis fibrosa, chronic osteomyelitis fibrosa cystica or solida, solitary bone cyst, etc., apparently have their origin in this way. Inasmuch as these solitary fibrocystic lesions start as a localized osteomyelitis in which cancellous tissue destruction, hemorrhage and hemorrhagic granulation tissue play the initial rôle, the writer believes that clinically the term hemorrhagic osteomyelitis is the more exact one to use. Whether or not the lesion has advanced from the hemorrhagic (solid) to the fibrocystic, or purely cystic, stage, can only be determined positively during operative interference and exposure, and then only may a conclusive diagnosis be reached.

The use of the X-ray must always be availed of for diagnostic purposes. At present it has its limitations in aiding us in this work.

We are unable to state from the skiagraphs whether or not the more or less symmetrical lesions the pictures usually show are hemorrhagic (solid), fibrocystic, or cystic, whether they possess, or are without, any lining membrane.

The distribution of these lesions that have come under the observation of the writer during the past three years are as follows: Femur, 8 cases, tibia, 3 cases, fibula, 2 cases, radius, 1 case, ulna, 1 case, ilium, 1 case, total, 16 cases. Four of the lesions of the femur were in the upper end in the region of the neck and trochanter.

In two of the cases we were able to secure skiagraphs showing the lesions previous to and following pathological fractures. Four cases were in the lower end of the femur. Three of these lesions involved one or both condyles. The other case showed the inflammatory process

CANCELLOUS BONE LESIONS

about 2 inches above the condyles. Three lesions in the tibia occupied positions in the lower end. We have two cases showing the process in the fibula, both in its upper end, one case in the lower end of the radius, one just below the olecranon, and one in the ilium.

Of the 16 cases personally observed 10 have submitted to operative interference.

Two cases apparently will not require operation, reparative change seemingly going on. Two others have refused operation but are being kept under observation. Two cases have been lost sight of.

In the 10 cases operated upon exposure proved 5 to be solid (hemorrhagic non-metaplastic type); 4 were fibrocystic in character (metaplastic type); and one case was frankly cystic.

In only one case previously reported (*Surg., Gynecology and Obstetrics*, July, 1914) has the writer felt it necessary to perform amputation for this lesion. The mutilating operation in this instance being preferred on account of the enfeebled general condition of the aged patient and his evident inability to withstand the shock of the more prolonged operation of resection and transplantation that would have been necessary to replace the diseased bone. In several cases the writer has been content to curette, swab the cavity with iodine, and close the wound. In others where the cavities were larger partial filling has been accomplished by shavings removed from the normal bone. The lesions have healed *per primam*. There have been no recurrences.

The ages of the patients have ranged from 3 to 63 years. They were all white; no cases in the colored races have thus far come under observation.

The size of the lesions have varied from that of a coffee bean to a large goose egg.

The relation of the size of the lesion to the duration of the disease is quite indefinite. X-ray studies and clinical observation indicate that as a rule the process is a slowly progressive one.

A definite history of initial trauma was obtained in two-thirds of the cases.

A majority of the lesions were subjected to Wassermann tuberculin or von Pirquet reactions. In every instance they gave negative results.

The period of time elapsing from history of injury to onset of symptoms has dated from receipt of injury to 18 months later.

No lining membrane was present in 9 of the 10 cases operated upon. In only one case did the lesion exhibit wholly fluid contents and in this case there was no lining membrane, the wall of the cavity was ridged and much more dense and compact than normal cancellous bone.

The gross and microscopic pathologic pictures of the (solid) hemorrhagic granulation tissue process are identical in the largest and smallest lesions

The clinical diagnosis of these lesions in the upper end of the femur is frequently difficult to make because they simulate very closely the symptom complex of hip disease of the acetabular type. The X-ray, of course, makes a correct diagnosis easy.

Two of the cases under observation, each one presenting a lesion in the lower end of the femur, are absolutely without symptoms at the present writing. Comparison of the X-rays taken recently with those taken several months ago shows decrease in size of the lesions and apparent regeneration taking place (Figs 15, 16, 17 and 18). The treatment in one case (Case No. XV) has consisted in the application of numerous plaster-of-Paris bandages to the affected limb beginning from the time the process was first discovered, six months ago. The second case (No. XVI), in which regenerative repair is apparently progressing, has received no treatment whatever apart from surgical attention given by incision and evacuation of a hæmatoma of the soft parts near the site of the bone lesion.

A careful study of the clinical, X-ray, operative gross and microscopic pathologic pictures of Case No. XVII leads to the assumption that the initial lesion must have been much larger than the X-ray picture now shows, anatomical restoration having been almost completely accomplished by nature's efforts alone.

Reports in detail of 9 of the 16 cases collected, belonging to this series, have been published in *ANNALS OF SURGERY*, February, 1913, and *Surgery, Gynecology and Obstetrics*, July, 1914. A brief sketch of the cases not previously reported is here appended.

CASE XI (October, 1913) —Beatrice W., female, white, age eight years. Whooping-cough and measles several years ago. No tonsillar infections. No other illnesses. Family history negative. History of fall and bruising left hip six months ago. Onset of present disease three months ago, with pain in left hip and limp since. Last two months has had night cries. Examination exhibits slight atrophy of thigh and calf muscles on left side. Measurements are Ra, 21¼ inches, La, 21 inches, has limitation of rotary motion in flexion, A G E, 175°, A G F, 80°.

Clinical Diagnosis —Left hip-joint disease of the acetabular type. X-ray (Fig 9) taken two days later shows an oval-shaped lesion occupying neck and trochanteric region of left femur about the size of a small hen's egg, the lateral boundaries of the lesion extending to the periosteal walls. X-ray diagnosis Hemorrhagic

osteomyelitis. Plaster-of-Paris spica bandages applied and reapplied until June, 1914.

Numerous X-rays taken during the interval show very slow progressive increase in size of the lesion, with increased limitation of motion of the limb. Wassermann reaction negative.

June, 1914, operation consented to. Exposure exhibited a hemorrhagic fibrocystic loose oedematous mass easily removed and separated with curette. There was free bleeding from the cavity walls which had no lining membrane. The naked eye appearance of the lesion was that of the transitional stage of localized hemorrhagic osteomyelitis, in which the solid mass was undergoing fibrocystic changes.

The microscopic report made from material curetted away is appended.

Examination shows a variable histological appearance. The bone trabeculae exhibit a slight degree of disorganization, and the medullary tissue evidence of fibrosis. The principal feature appears to be the presence of new-formed tissue composed for the most part of medium-sized fibroblastic cells. Here and there a multilobulated nucleus is seen and a rare mitotic figure. A few giant-cells of the foreign body type are observed about the areas of disintegration, together with moderate hemorrhage, scattered foci of pigmented cells, and round-cells.

CASE XII.—Francis M., male, white, age six years, well-nourished, healthy looking. Family history negative. No tonsillar infections. Measles and whooping-cough at eighteen months. No other illnesses.

One year ago fell down a flight of stairs, dislocating left shoulder and bruising left hip. Began to limp four weeks ago. Has no pain, no night cries. Examination shows slight atrophy of thigh and calf muscles on affected side. Is tender to pressure over trochanter. Left measurement $\frac{1}{8}$ inch less than right. Rotation in flexion and hyperextension slightly limited.

Tentative Clinical Diagnosis.—Left hip disease acetabular type. X-ray picture (Fig. 10) exhibits a lesion oval in shape the size of a bantam's egg, occupying most of the neck and portion of the trochanteric region and extending laterally to the periosteum. A practical replica of Case XI.

Clinical and X-ray Diagnosis.—Hemorrhagic osteomyelitis. Wassermann and von Pirquet negative.

Operation advised and consented to. While awaiting room for admission to the hospital patient was put up in spica plaster-of-Paris dressing.

Several weeks later he was carried to the hospital and statement made that some hours previously he had tripped and fallen, was unable to rise or move the left leg, and was suffering great

pain Plaster was immediately removed and an X-ray (Fig 11) taken which shows a pathologic fracture at the upper boundary of the lesion without deformity

Operation (June 14) —Operator, V P Gibney Exposure shows darkened periosteum, a slight blow of the chisel easily penetrated the cavity from which fluid straw-colored contents were evacuated

The lining wall of the cavity was hard and dense and was felt to contain numerous slight ridges There was no lining membrane

CASE XIII —Vivian J, female, white, age four years, well-nourished Family history negative Has had several attacks of tonsillitis Scarlet fever eighteen months ago Malaria with convulsions one year ago. Whooping-cough last winter

Eighteen months ago fell out of bed Mother thought child was seriously hurt Doctor's examination negative Began limping four weeks ago Has no night cries Two weeks ago parent first noticed that when patient would go upstairs she dragged the left leg Examination gives negative joint symptoms, measurements of lower extremities are the same Slight pressure over left trochanteric region causes discomfort, deep pressure makes child cry

Clinical Diagnosis —Hemorrhagic osteomyelitis X-ray (Fig 12) shows the lesion in the upper end of the femur practically a duplicate of the two cases above reported Three days after this X-ray was taken the child was again brought to the hospital with the report that a few hours before she had tripped and fallen, was unable to move her leg, and was screaming constantly from pain

Another X-ray (Fig 13) was immediately taken which shows fracture through the lesion with more deformity than was exhibited in Case XII This is no doubt due to the fact that no plaster spica had been applied previous to the accident

We are fortunate in being able to exhibit the lesions in Cases XII and XIII just previous to and immediately following pathological fracture

It is a singular coincidence that Cases XI, XII, and XIII are practically duplicate and that in each case the upper end of the left femur is involved

CASE XIV (Dr W Frieder has been kind enough to refer to and give me the following data from his notes in this case) —Dora K, female, age twenty-two years, came under observation about six and a half years ago complaining of discomfort and pain in right thigh Definite enlargement of trochanteric region was noted An X-ray was taken which showed a lesion occupying the neck and trochanteric region of the right femur Six years

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ago an operation was performed by cutting into and curetting out the mass of sanguineous gelatinous material of which the lesion was composed.

A microscopic examination was made of the curettings and a diagnosis given of giant-cell sarcoma.

The X-ray (Fig. 14) recently taken shows the condition of the upper end of the femur six years after operation. She still complains of occasional discomfort in her hip. Several Wassermanns were negative.

CASE XV.—Alice P., female, white, age seven years, well-nourished, healthy looking. Family history negative. No tonsillitis, pneumonia, or other infective diseases. No history of injury.

About nine months ago child's mother noticed that the left knee seemed larger than the right and thinks it has slowly increased in size since. Has no pain and no night cries.

Examination shows enlargement of left knee. Circumferential measurement is $\frac{3}{4}$ inch greater than right. Sensitive to slight pressure just above the condyles; deep pressure causes pain. X-ray (Fig. 15) taken February, 1914, exhibits an osseous lesion above the condyles. Wassermann and von Pirquet reactions negative.

Diagnosis.—Hemorrhagic osteomyelitis. Operation refused. Plaster-of-Paris bandage applied, and others renewed from time to time since. X-ray (Fig. 16) taken August, 1914, shows bone regeneration taking place and a decrease in size of the lesion. Deep pressure over the site of the lesion does not now cause pain. Circumferential measurement of the knee reduced $\frac{1}{8}$ inch. Plaster bandage discontinued.

CASE XVI.—James C., male, white, age three years, healthy, well-nourished. Fell down four steps of stairway two months ago. Same night became very restless and cried from pain located above right knee-joint. No ecchymosis or swelling present. Apparently well three or four days later. About three weeks later mother observed that lower end of right thigh was much swollen and sensitive to touch. Home remedies having failed to reduce swelling, she now presents patient for treatment.

Examination shows lower end of the right thigh to be swollen; a fusiform area of fluctuation above the inner condyle is present. Measurements of left knee $9\frac{5}{8}$ inches, right knee $9\frac{7}{8}$ inches. An incision was made over the fluctuating area above the condyles and contents evacuated.

Clinical diagnosis: Hæmatoma. X-ray (Fig. 17) taken at this time shows a cancellous bone lesion present the size of a small lima bean, situated in the inner condyle of the right femur and extending to the epiphysis. Von Pirquet negative.



FIG 11 —Case XII X-ray taken five weeks later (same patient) showing fracture of the femur at upper end of the lesion, practically no deformity present probably due to the fact that at the time of accident patient was wearing a spica plaster-of-Paris dressing



FIG 12 —Case XIII Hemorrhagic osteomyelitis X-ray shows oval-shaped lesion of upper end of femur size of a bantam's egg

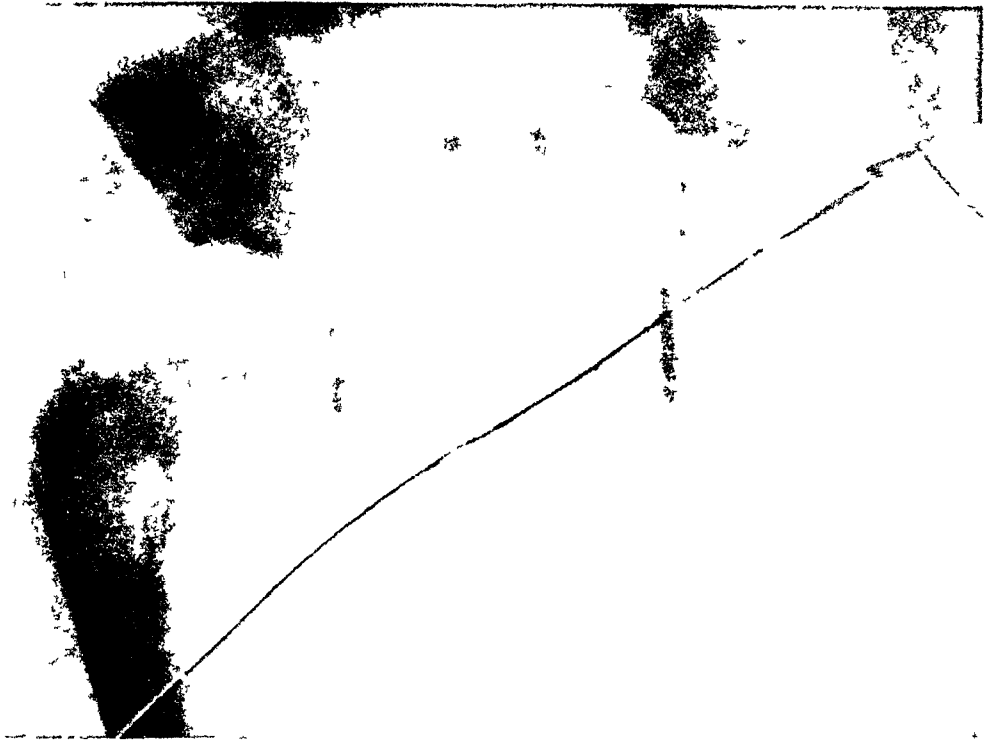


FIG. 13.—Case XIII. X-ray of same patient taken three days later showing fracture of lesion due to fall.



FIG. 14.—Case XIV. X-ray of same patient taken three days later showing fracture of lesion due to fall.

FIG. 15.—Case XV. X-ray of same patient taken three days later showing fracture of lesion due to fall.

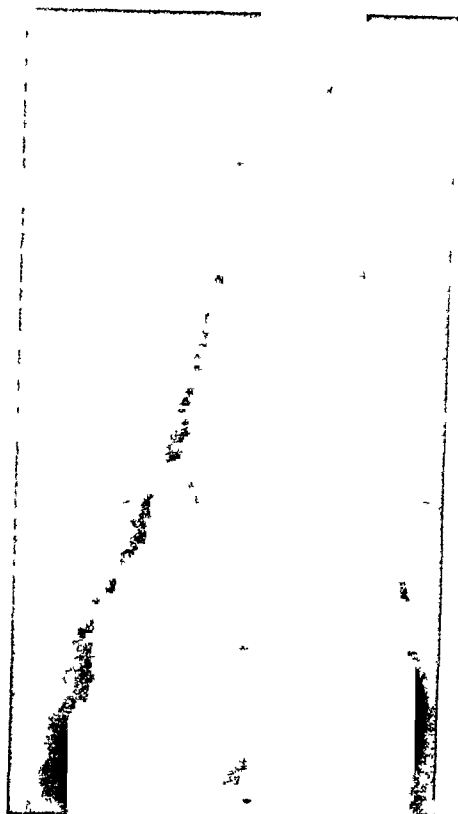


FIG 16 —Case XV X-ray taken six months later shows apparent regeneration and decrease in size of the lesion even allowing for and taking into consideration the difference in density and size of skiagraphs



FIG 17 —Case XVI Hemorrhagic osteomyelitis X-ray showing lesion in lower end of right femur extending to the epiphysis, size of a lima bean

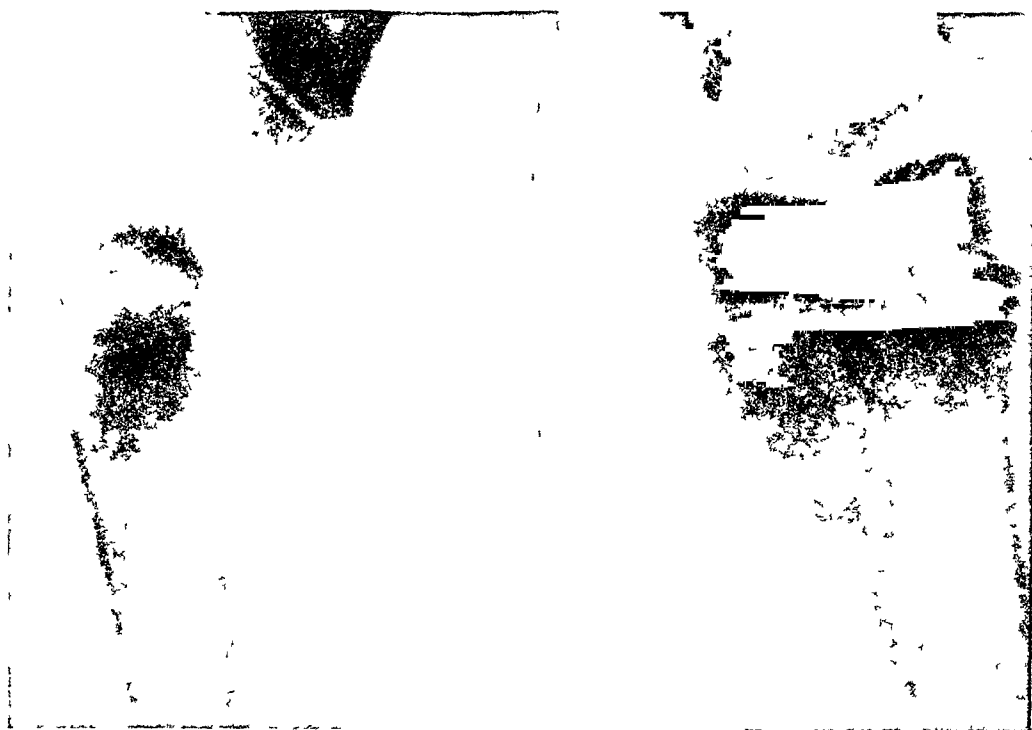


FIG 18 —Case XVI X-ray case three months later, showing apparent regeneration.



FIG 19 —Case XVII Hemorrhagic osteomyelitis X-ray shows small lesion posterior border of end of shaft and symmetric enlargement of lower fourth of the bone

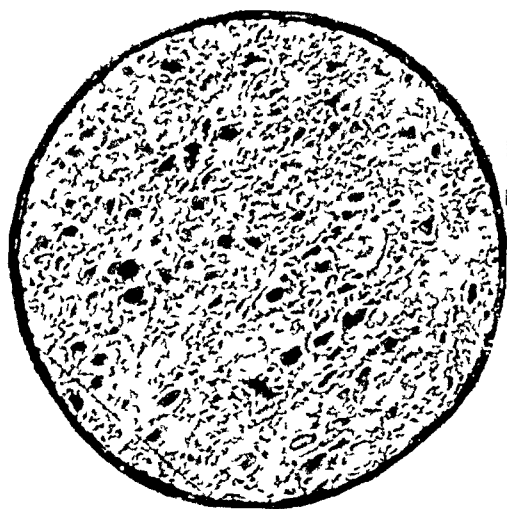


FIG 20 —Photomicrograph Hemorrhagic osteomyelitis. A typical field showing numerous giant cells. Section taken from one of the lesions operated upon. Solid hemorrhagic granulation tissue type (X80)

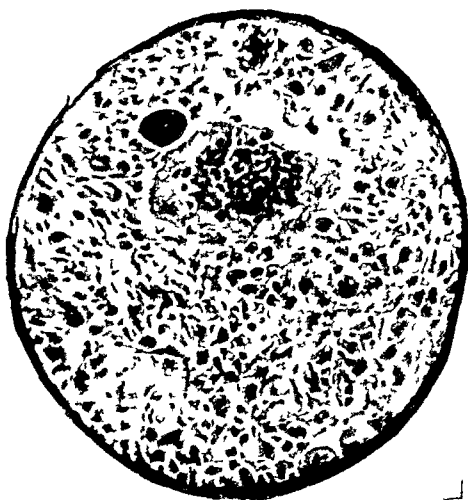


FIG 21 —High power photomicrograph showing multinucleated giant-cell (X220) Hemorrhagic osteomyelitis

NOTE —The characteristics of this scavenger (giant) cell that differentiate it from the malignant true tumor giant cell are the following (1) The numerous nuclei present, (2) regularity of their arrangement, (3) uniform size of the nuclei (4) the absence of mitotic figures, (5) vacuolation and abundance of the cytoplasm

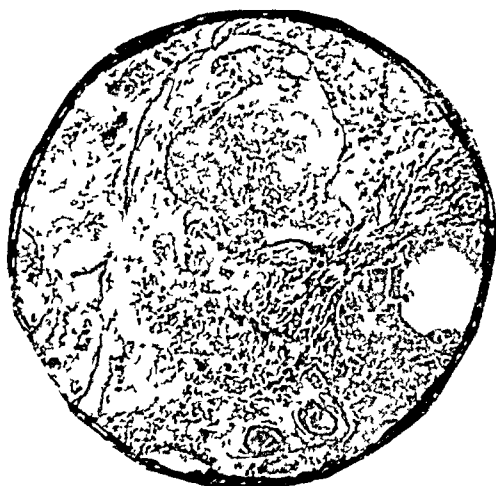


FIG 22 —Hemorrhagic osteomyelitis. Photomicrograph from cut section showing dilated and engorged blood-vessels, hemorrhage into perivascular tissue and erosion and disintegration of bone trabeculae

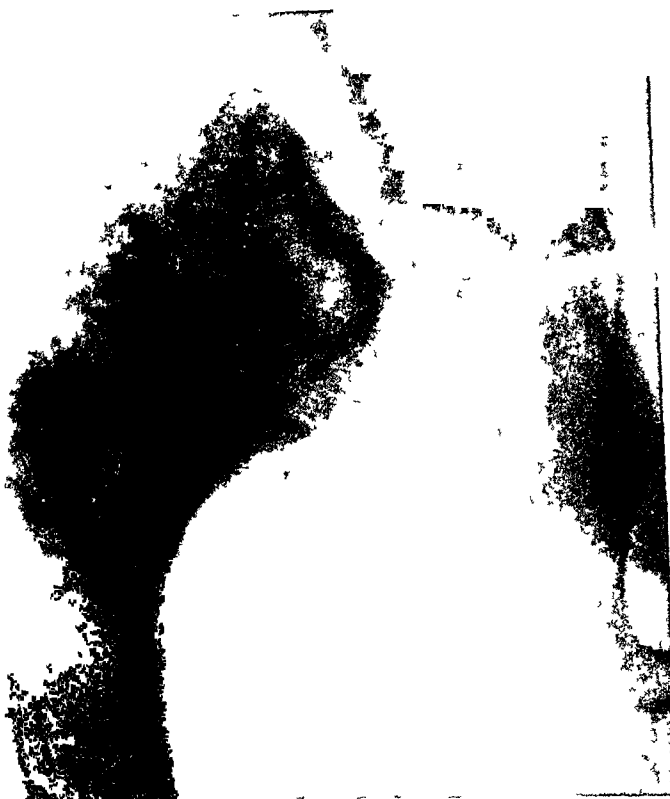


FIG 23 —Case I Osteochondrofibroma X-ray showing hypertrophy and obliteration of normal contour of upper end of left femur



FIG 24 —Case I Osteochondrofibroma Artist's drawing actual size of a cross-section of the gross lesion

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Diagnosis—Hemorrhagic osteomyelitis and hæmatoma of soft parts X-ray (Fig 18) taken three months later (August, 1914) shows regeneration and decrease in size of focus Measurements of both knees are the same The child exhibits no disability No treatment or measure of immobilization has been applied Anatomical restoration is apparently taking place without it

CASE XVII—Howard H., male, white, age six and one-half years Family history negative Has had measles, no other infectious diseases or illnesses No history of injury Fourteen months ago began complaining of crampy pains in right leg, at times very severe, which would frequently awaken him out of a sleep These pains in the leg have been more or less constant for about one year For several months has been unable to stand any pressure over the front of the leg in its lower third The patient limps and at times is unable to walk Has been treated for rheumatism for past nine months

Examination exhibits a uniform non-inflammatory enlargement of the lower third of the right leg, it is quite sensitive to touch and causes pain on deep pressure X-ray (Fig 19) shows an irregular semi-oval spot on the posterior lower border of the right tibia It also shows a uniform hypertrophy of the lower fourth of the bone Wassermann negative

Operation (June, 1914)—Exposure and cutting into the bone exhibits very vascular cancellous tissue A small piece of much softer structure the size of a bean removed The cavity curetted, swabbed with iodine and wound closed

Microscopic Report—Specimen consists of a few small, soft pieces of bone curettings Microscopic examination shows congestion in cancellous tissue, otherwise nothing unusual found

COMMENT—The reporter ventures the opinion (based upon an analysis of the clinical, X-ray, gross and microscopic pictures presented by this case) that previous to operation nature had been successful in accomplishing almost complete regeneration of the diseased bone The hypertrophied lower end of the right tibia, and history of long disability in conjunction with the microscopic findings of the removed tissue indicate that the initial lesion must have been much larger than the focus now presented by the X-ray (Fig 19)

GROUP 3 OSTEOCHONDROFIBROMA—CONGENITAL (BENIGN BONE TUMOR)

This cancellous bone lesion must be regarded as a true tumor—that is, an autonomous growth of benign characteristics possessing the potentialities for sarcomatous degeneration

Diagnosis—Hemorrhagic osteomyelitis and hæmatoma of soft parts X-ray (Fig 18) taken three months later (August, 1914) shows regeneration and decrease in size of focus Measurements of both knees are the same The child exhibits no disability No treatment or measure of immobilization has been applied Anatomical restoration is apparently taking place without it

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GROUP 3 OSTEOCHONDROFIBROMA—CONGENITAL (BENIGN BONE TUMOR)

This cancellous bone lesion must be regarded as a true tumor—that is, an autonomous growth of benign characteristics possessing the potentialities for sarcomatous degeneration

Several theories obtain as to the etiology of this growth According to Virchow rickets is the prime factor In the latter disease in the region of the epiphysis is found very extensive cartilaginous development, and processes of new cartilage project into what is destined to be the shaft of the bone, this may be cast off and isolated from the main mass Under certain conditions these islands take on independent and aberrant growth, giving rise to enchondromata, osteo-enchondromata or true osteomata Most modern authorities believe these growths arise from embryonal or developmental rests and are therefore congenital

In this group only one case has been personally observed It is here recorded on account of its rarity as a single growth in the cancellous bone and because of the interesting features it presents

The following is the case history

George C, male, white, age twelve years, well-nourished Family history negative Has limped since he was two years old No history of injury Has never had any tenderness or pain in affected limb.

Examination shows marked external lateral bowing of trochanteric region of left thigh There is limitation of motion of hip-joint, atrophy of lower thigh and calf muscles, and considerable shortening of the limb

Measurements La, 27 inches, Ra, 28½ inches In the erect position patient balances himself on the ball of the left foot, heel raised

X-ray (Fig 23) taken previous to operative interference shows marked hypertrophic disease of the upper end of the left femur X-rays were also taken of the rest of the skeleton, all other bones giving a normal picture Wassermann negative

Operative exposure and removal of diseased bone show the growth to be a typical osteochondrofibroma

As the cut gross section could not be brought out in detail on a photographic plate, the artist (Bosse) made an actual size drawing (Fig 24)

The microscopic report (of sections of the growth) made by Dr O S Hillman is as follows:

Microscopic examination shows the tumor to be made up of a framework of cellular fibroblastic tissue with rather delicate bone trabeculae embedded in it and circumscribed areas of cartilage

The growth is covered by a fairly dense connective-tissue capsule, only a moderate number of blood-vessels are seen throughout the fibrous portion of the mass No definite evidence of malignancy can be detected

The growth is essentially an osteochondrofibroma

MULTIPLE CONGENITAL OSTEOCHONDROMATA

By R. D. CARMAN, M.D.

OF ROCHESTER, MINN

AND

A. O. FISHER, M.D

OF ST LOUIS, MO

(From the Department of Surgery, Washington University)

G H, a white male, aged thirty, unmarried, was admitted as a patient on the Surgical Service of the Washington University Hospital, St Louis

He presented himself for the treatment of a superficial abscess over a bony prominence on the left clavicle. On examination, a most remarkable condition involving practically the whole skeleton was disclosed.

A study of this case, including the X-ray findings, is the basis of this report.

Family History—His parents are both living. The father, seventy-one years old, is well preserved and in very good health. The mother, aged fifty-four, is not strong and for many years has been in poor health. The nature of her trouble is not known. He has three sisters and five brothers all in good health and none of them, to the best of his knowledge, has any trouble similar to his own. Two brothers died in infancy and one sister died at nineteen, the cause of death being unknown. Two maternal aunts died of tuberculosis. He knows nothing of his grandparents and, so far as he has been able to learn, no condition similar to his has ever been present in any member of his family.

Personal History—Patient has never been robust, but his general health has been fairly good. He had none of the serious diseases of childhood. At the age of twenty-three he had typhoid, from which he made a good recovery, without complications.

He has had two attacks of pleurisy in recent years and one attack of malaria. He has suffered frequently from headaches accompanied by gastro-intestinal upsets. Aside from the so-called attacks of pleurisy, there have been no symptoms referable to the cardiorespiratory system. His appetite has never been good, he has been a small eater and has always been troubled with constipation, otherwise his gastro-intestinal history is negative. He had a Neisser infection a few years ago but denies lues. There is no history suggesting a primary or secondary infection.

Neuromuscular system is negative. He has been a man of regular habits. Up to six years ago he did hard manual labor on a farm, but since that time has been a book-keeper.

Present Illness—He has had multiple hard tumors all over his body as long as he can remember and at birth it was noticed that his arms were

thick at the elbows and wrists. His mother stated that, up to the time he was about six years old, the lumps were not noticeable enough to attract attention, but at that time they began to grow, particularly those on the extremities. They grew proportionately to the general growth of the body and during the period of adolescence, from 16 to 22, their growth was most marked. Since the age of 22 he thinks they have stopped growing. In other respects his development has gone on normally and he has suffered no inconvenience from the presence of these tumors, except for the resulting deformity in his forearms. The limitation of motion produced here has made it necessary for him to give up hard manual labor.

Subjectively, he has been quite free from symptoms referable to the tumors. None of the long bones have ever been fractured. He had never sought medical advice and the only reason for coming at this time was for the treatment of an abscess caused by the rubbing of his clothing over a prominence on his left clavicle.

Physical Examination—The patient is a fairly well-developed man, 5 feet 5½ inches in height. He shows no evidence of malnutrition or emaciation and is suffering no discomfort. There is a striking irregularity in the contour of the body and scattered over the trunk and limbs are numerous tumors arranged more or less symmetrically, which cause marked deformities in the bony framework, as shown in Figs. 1, 2 and 3.

The skull is apparently normal in shape and size and is the only part of the body which is free from the tumors. The jaws are prominent and somewhat thickened, especially the right one at the angle. The eyes are negative, no pathological changes in the fundi. The color fields show no restriction or abnormality. The nose is free from any bony deformity. The teeth are normally situated, are all present and in good condition. There are no deformities along the alveolar borders. The nasopharynx is negative.

There is no enlargement of the thyroid gland or of the lymph-glands in the neck or elsewhere. The heart and lungs are negative. The chest is asymmetrical, though fairly well developed, and moves normally on respiration. There are multiple tumors on the ribs averaging in size from a few millimetres to about two centimetres across. They are scattered everywhere, without reference to the costochondral articulations, and are all of bony hardness. They suggest exostoses and no diffuse enlargement of the ribs can be determined. The spine on examination feels normal except for a slight lateral deviation, no tumor masses being palpable.

The upper extremities. The right shoulder is much more prominent than the left, although on both sides there is a diffuse enlargement of the upper humerus, especially marked anteriorly. The muscles here, as elsewhere, are fairly well developed and there is practically no restriction of motion at the shoulder-joints. The right clavicle is more prominent than the left, but no nodules can be felt. At the left acromioclavicular joint is a very prominent bony mass, 6 × 8 cm. in diameter, over the apex of which the skin has broken down and is the site of an abscess.

The scapulæ are not markedly deformed and neither is winged, but

the left one is somewhat more prominent than the right and has numerous nodules scattered over the wing and spine measuring in size from 3 to 8 cm. There are fewer on the right side.

The right humerus is a little longer than the left, neither is markedly shortened. The right measures 32 cm, the left 28 cm. Except for the diffuse enlargement about the heads, both bones on palpation seem quite normal between the shoulder and elbow.

The most striking deformities are present in the forearms, particularly the left. Both are much shortened and the shafts, as well as the ends, are involved in the deformities. On the left side the bones are so distorted that the radius and ulna cannot be distinguished from one another. Extension and flexion are possible within almost normal limits, but pronation and supination are practically nil.

The right forearm is much less deformed, although the enlargement at the elbow-joint is much greater than on the left. Pronation in this arm is fairly good, but supination is impossible. The left forearm, from the external condyle to the styloid of the ulna, measures 14 cm, the right 21 cm. From the external condyle to the styloid of the radius, the left measures 16 cm, the right 21 cm.

There are multiple nodules to be felt about the right elbow-joint. Motion at the wrists is only slightly restricted and the hands, except for being somewhat chubby, show no very striking abnormalities. The last two fingers of the left hand are disproportionately shortened.

Numerous small nodules are palpable along the metacarpals and the phalanges.

The lower extremities. The pelvis is tilted, the right side being higher than the left. The ilium on either side is covered with nodules, both anteriorly over the crests and posteriorly. The left femur shows no marked changes at the upper end, but there are numerous nodules about the lower end, while the shaft seems clear and normal in length. There is no restriction of motion at the hip. The right femur presents a very large tumor posterior to the great trochanter and another just below this. On this side there is slight restriction of motion at the hip-joint, due to the mechanical interference of some of the larger tumors. The shaft again is normal, but at the lower end there is a more marked deformity than on the left, causing a definite genu valgum.

The bones of the lower legs all show thickening about the articular ends, with numerous palpable nodules. The shafts are clear and there is no shortening or marked deformity analogous to that present in the forearms. There are no palpable tumors on the feet, but there is some irregularity in the arrangement of the toes. The third toe on either foot is set back 1 cm. behind the others and is proportionately smaller. There is a moderate degree of flat-foot.

The left leg measures somewhat shorter than the right, but there is no noticeable limp in walking. Motion is nowhere restricted at any of the joints.

On inspection and palpation these tumors are all characterized by their bony hardness and their irregularity as to size and shape. Some

FIG 1



FIG 2



FIG 3



FIGS 1 2 and 3 —The head is normal in size and shape. Marked deformity of the upper extremities particularly the left forearm and shoulders, with relative shortening of the arms, more marked on the left. Small tumors scattered over the ribs, larger ones in the region of the hips, especially the right. Legs normal in length. In general, the distribution of the tumors is fairly symmetrical.



FIG 4 —The skull and upper cervical spine. The skull shows marked thinning in the vertex and the frontal eminences. Size and shape normal. Sella turcica normal. No bony outgrowths. The right lower jaw shows a marked exostosis at the angle with thickening and irregularity of the ascending ramus. The freedom from involvement of the bones laid down in membrane is striking. The posterior spinous processes of the second and third cervical vertebrae show diffuse enlargement and bridging. The rest of the spine is normal, except for fusion of the fourth and fifth lumbar vertebrae.

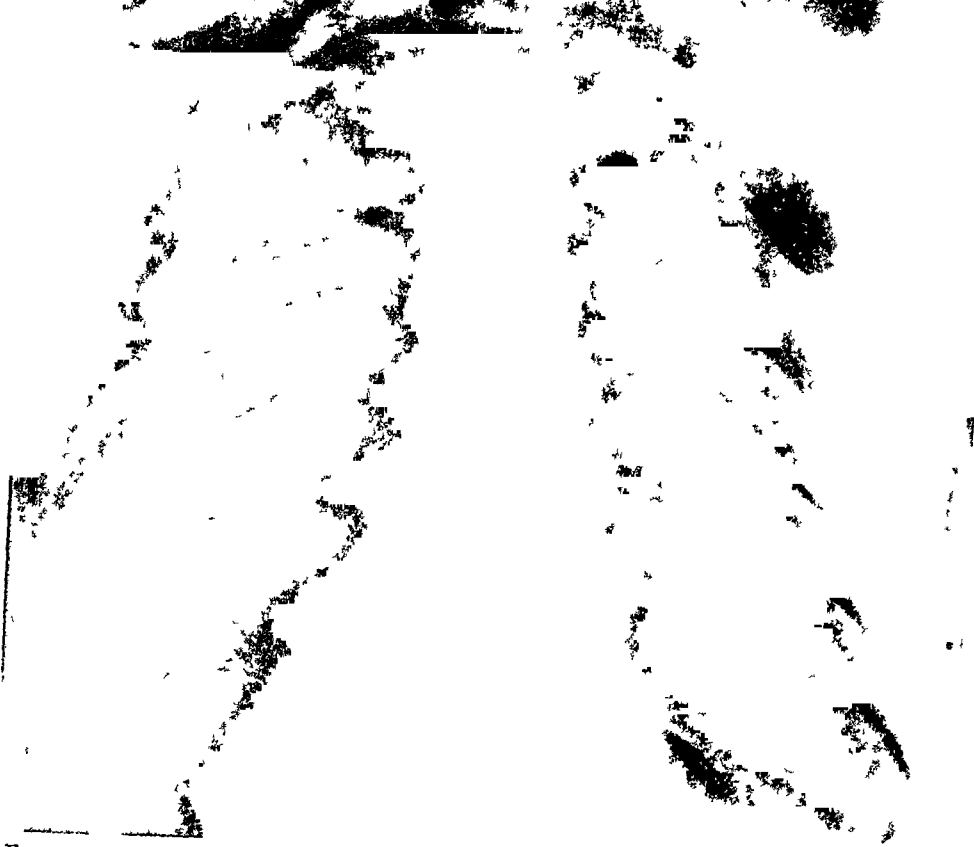


FIG 5 —The thorax. On left side multiple exostosis on third and fifth ribs. On the right side the first second and third ribs show marked deformity. Notice especially the third which at one point is incorporated in an irregular bony mass which displaces the ribs above and below it and causes them to overlap. Lower six ribs but slightly involved. Some clubbing at the costochondral articulations.



FIG 6 —The left shoulder. The inner end of the clavicle is normal. At the outer end there is a large irregular mass which contains cystic cavities and involves the entire outer end and the acromion. The inner border of the scapula is irregular and on the outer border at the junction of the middle and lower third is a large rectangular exostosis. The upper border is obscured. The upper third of the humerus is enlarged and club shaped and shows a large single cavity with bony partitions. The cortex is irregular thinned out and in places seems to be broken through particularly on the inner border. The lower two-thirds of the humerus are normal except for one small exostosis on the internal condyle.



FIG 7 —The right shoulder The clavicle here is normal except for an exostosis at the outer end on the under surface where there is cystic degeneration and the cortex is broken through The scapula shows an exostosis on its posterior surface lower third while the whole inner border is thickened The acromion is free The humerus shows the same condition as that on the left, but the cortex here seems everywhere intact The same bony partitions as on the left are seen in the enlarged cystic head The rest of the humerus is normal except for one exostosis on the internal condyle

FIG 8



FIG 9



FIGS 8 and 9 —The left forearm The bones are greatly shortened and deformed The ulna is the larger bone its upper end shows little change The shaft is short and stout while the lower third is spread out into a large mushroom growth displacing the radius inward The enlargement shows trabeculae with minute cysts The shaft of the radius is very thin and twisted around the lower ulna and its upper end is deformed by a bony overgrowth Stereoscopic plates show these bones to be distinctly separated from one another The lower end of the radius is somewhat deformed but its articular surface is little changed The elbow-joint is negative

FIG 10



FIG 11



FIGS 10 and 11 — The lower right humerus and elbow joint the bones of the forearm and carpus. Except for the presence of a few small exostoses about the condyles the lower humerus is normal. This condition also prevails on the left side. The upper ends of both radius and ulna show some deformity due to the presence of small multiple exostoses. The shafts of the two bones are of about the same size the radius being more nearly normal. There is an exostosis on its ulnar side. The ulna is deficient in its lower third and spread out. Its radial side is rough and irregular. There is not the marked shortening of the bones which was present in the other arm. The carpal bones in this as well as in the other wrist show no marked abnormalities.



FIG 12 — The left hand. The bones all show clubbing and shortening with the exception of the metacarpal of the index finger which is normal. This abnormality is particularly well seen in the other metacarpals. The whole hand is stubby. There are a few scattered exostoses to be found about the ends of some of the bones and in places a beginning cystic degeneration.



FIG 13 — The right hand. The bones of this hand are more uniformly thickened and clubbed than those of the left hand. The distal ends of all of them almost without exception bear small exostoses. There is also evidence of early degeneration in the ends of some of them. The thickening of the shafts is very well shown in the phalanges of the first, second and third fingers.



FIG 14.—The pelvis and upper femora. The pelvic bones are enlarged and show multiple exostoses, irregular in size and distribution. One especially marked on the posterior surface of the left ilium. A large mass on the anterior surface of the sacrum projects into the pelvic cavity. One occupies the obturator foramen on the right side. The upper end of the femur on either side is greatly enlarged and club-shaped with cystic cavities as in the humeral heads. The neck is practically obliterated and there is marked irregularity and proliferation along the inner borders from the lesser trochanter to the head. A large branching cauliflower exostosis with a stout bony pedicle arises from the outer posterior surface of the right femur. This mass shows cystic degeneration. A second large tumor arises from the shaft immediately behind this one. The middle third of either femur is normal.



FIG 15 —The right knee The lower femur and upper tibia are enlarged and both show marked thinning of the cortex As seen elsewhere there is the tendency to cavity formation and there are numerous exostoses on the posterior surface of the femur and the inner surface of the tibia There is no deformity of the joint itself



FIG 16 —The upper ends of the left tibia and fibula The head of the fibula is spread out and shows the characteristic cystic degeneration This is not so evident in the tibia but here there is also marked thinning of the cortex On the fibular side of the tibia the cortex is absent in one place and there is fusion with the fibular head There are numerous exostoses on the inner side of the tibia The shafts of the bones are relatively normal in size and shape



FIG 17 —The right lower leg and tarsus The lower ends of the tibia and fibula in both legs show almost the same picture There is some enlargement of the bones with thinning of the cortex and cystic formation The tarsal bones are larger than normal The os calcis shows an exostosis on the upper posterior border at the insertion of the tendo Achilles and another on the plantar surface The left tarsus is normal except for slight enlargement of the os calcis



FIG 18 —The anterior portion of the right foot. First and second metatarsals normal except for slight clubbing. The third, fourth and fifth are all short and clubbed with fusion of the third and fourth at their distal ends. Phalanges of the second, third fourth and fifth are all short and clubbed, with a median constriction of the first phalanx of the third toe. The metatarsals and phalanges of the left foot all show clubbing with numerous small exostoses.

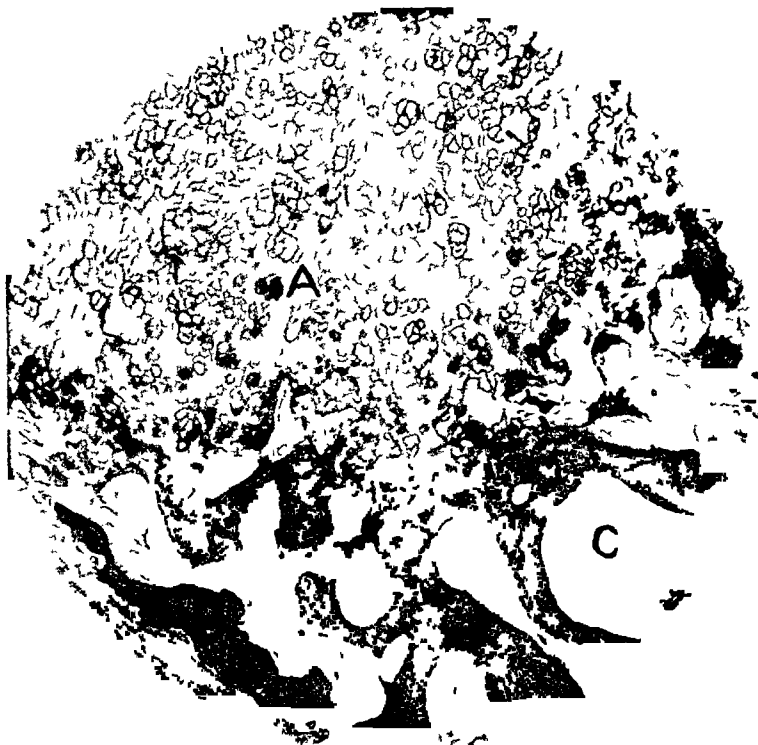


FIG 19 —Section through the outer bony shell of one of the exostoses. A hyaline cartilage with atypical cells, marked calcium deposits, B fragments of dense bone, C myxomatous connective tissue and fat.

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appear as typical exostoses, others as diffuse enlargements of the entire bone

Rectal examination reveals a bony prominence projecting into the pelvis from the right ischium and pubis. There are no palpable masses arising from the coccyx or sacrum as far as the palpating finger can reach.

Abdominal examination is quite negative. Liver and spleen are of normal size. There are no palpable masses or areas of tenderness. The genitalia show no abnormalities.

The urine is free from sugar and albumin, and repeated tests for the Bence-Jones proteid are negative.

The blood picture is normal. There are 5,100,000 red cells and 9,000 leucocytes. A differential count of 400 cells shows lymphocytes 17.5 per cent, large mononuclears 7.0 per cent, polymorphonuclears 72.5 per cent, eosinophiles 2.5 per cent, and mast-cells 0.4 per cent. No pathological changes are seen in fresh or stained smears.

The Wassermann reaction is negative.

The sugar tolerance was lower than normal. For glucose it was found to be between 15 and 25 grammes, and for levulose, between 5 and 10 grammes.

The tolerance was in no way influenced by the feeding of pituitary extract (anterior lobe).

The abscess mentioned above was incised and drained and, when the infection had cleared up, a portion of the bony tumor under it was removed. At operation the tumor was found to be a cystic growth with a thin, hard, bony wall, arising from the outer end of the left clavicle.

Rontgenograms of the entire skeleton were made and their description accompanies the illustrations.

NOTE—We desire to acknowledge our appreciation to Mr C. A. Heckelman for the preparation of the rontgenograms and to Dr W. S. Thomas for the microphotographs.

Pathological Report—A portion of the tumor removed from the left clavicle shows the following picture.

On section the fresh gross specimen presents an outer shell of dense bone, which varies in thickness from 1 to 10 mm and in places contains white, chalky deposits, which are brittle and can be scraped away. The inner portion is spongy, soft and trabeculated and contains an irregular cavity about 1 cm in diameter, which is lined by a distinct membrane about 1 mm in thickness, resembling fibrous tissue.

Sections through the thick chalky portion of the outer shell, Fig 19, show the specimen to be made up of three distinct types of tissue: bone, cartilage and myxomatous tissue. The bone and cartilage are distributed irregularly, there being no very distinct line of demarcation, while scattered throughout the sections are deposits of calcium salts. The cartilage cells are rather indistinct, owing to the diffuse calcification. The myxomatous connective tissue is distributed in irregular areas, irrespective of bone or cartilage.

There are no evidences of inflammation or active bone destruction. Other sections made through the wall of the cystic cavity show this

CARMAN AND FISHER

to be lined with a layer of rather dense fibrous tissue, through which are scattered deposits of calcium, with bits of bone and cartilage and other areas of fat and myxomatous tissue. Here again there is no evidence of inflammation. There is no striking vascularity of the connective tissue.

The case presents a number of features of special interest. Such a general involvement of practically the entire skeleton is relatively uncommon, the majority of the numerous cases reported in the literature being limited usually to lesions in the long bones of the extremities and the short pipe bones of the feet and hands. In this case the bones of the skull and face are the only ones not involved. This is the usual observation and is explained by the fact that these bones are laid down in membrane instead of cartilage.

The influence of heredity, which has been observed repeatedly and which is apparently unquestioned, does not enter as a factor in this case, although it cannot be entirely excluded, since the information on this point is meagre. So far as his immediate family is concerned, however, nothing similar to his condition is present. Perrin has recently reported three cases occurring in the same family and has collected 33 observations by other authors, in which heredity has been an important feature.

The progress of the tumors, which was extremely slow up to the age of puberty and most rapid from this period to the age of 23, is quite in accord with the usual history and the observation of Virchow and others, that the condition develops most rapidly during the growing period. With the cessation of the general growth of the body, the condition has remained practically unchanged.

The general involvement of the epiphyses, with the relative freedom from involvement of the shafts, is very striking and seems to support the most plausible theory advanced by Von Bergman and others with reference to the etiology of this condition, namely, that the lesions arise in abnormal anlage in the intermediary cartilages. Von Recklinghausen believes that there is usually an increased and faulty vascularization of these cartilaginous infolds and that this is an important factor. In our case certain abnormalities, particularly about the elbow-joints, were noticed at birth and Pels-Leusden contends that the anlage are always present at that time, but may be too small to be observed, or obscured by the soft parts. These cartilaginous infolds may be present at any point and it is readily conceivable that they may become detached from their normal position at the epiphyseal lines and be carried along with the growth of the bones, to develop later in the exostoses, which are frequently found along the shafts of the long bones. It seems less

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probable that these lesions may be due to an inflammatory process and in this case there is certainly no evidence to support this view

Volkman lays considerable stress upon rickets as an etiological factor, but most other writers are not in accord with this view and Pels-Leusden correctly describes a different histological picture for the two conditions. In rickets the deformities are usually in the shafts and, while the epiphyses may be increased in size, they are usually normal in shape. Both conditions, however, may be present.

Other theories which have been advanced are, that it is a true heredity monstrosity or the manifestation of a derangement due to toxic infection, which is transmitted from generation to generation.

Aside from the suggestion of the trident hand, it bears no other relation to the condition of achondroplasia.

The absence of joint involvement is in accord with the general observation that the joints are rarely affected. There is some mechanical limitation of motion, however, at various joints, due to the neighboring tumors and deformities. In our patient there was marked shortening of some of the bones, especially those of the forearms, in which the deformities were most marked, and in the short pipe bones of the hand where there was very little actual deformity aside from the clubbing. Bessel Hagen believes that the bones are always shortened, while Niederle says they may be longer than normal and reports such a case.

In this case there is both central and peripheral involvement, the former manifesting itself as a very general diffuse enlargement of the long bones, the latter as typical exostoses arising from the cortex of practically all the long bones.

The cystic formation which is present in practically all of the lesions is a most striking feature and apparently unusual, since Borchardt and others have described such cysts as being isolated lesions and rarely multiple. Whether these areas of cystic degeneration can be considered as true bone cysts is a question. They are doubtless formed by the degeneration of the cartilaginous overgrowths. Virchow, in 1876, first described such a condition in the upper end of a humerus, where there was no bone expansion. He described the cyst as being lined with fibrocartilage and fibrous connective tissue. Bloodgood, in his contribution on bone cysts, considers true central enchondromata extremely rare and finds only four such cases with cysts since the original observation of Virchow and considers these as accidental findings, with no relation to true bone cysts. The most of Bloodgood's cases of bone cysts had a definite relation to *ostitis fibrosa* of von Recklinghausen and Paget, but this is an inflammatory condition, it may be the result of

trauma and its origin is never in cartilage. All of these features are quite at variance with the findings in our patient. Anschutz, in the report of a case of enchondroma, dwells at some length on the differences between these two conditions.

Cystic degeneration has also been observed in a variety of other bone lesions, among them may be mentioned central sarcomata, myxomata, arthritis deformans, callous cysts and subperiosteal hæmatomata.

Sections from the single tumor which was removed in our case are consistent with the view that in this condition we have the result of an abnormal and misplaced growth of cartilage, which has undergone cystic degeneration.

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A PRELIMINARY REPORT ON A STUDY OF THE PROTECTIVE FERMENTS OF THE BLOOD BY THE ABDERHALDEN METHOD, AFTER THE TRANSPLANTATION OF ORGANS *

BY CHARLES GOODMAN, M D.
OF NEW YORK

At the recent meeting of the International Congress of Surgeons, Carrel reiterated his former statements to the effect that he had met with considerable success in autotransplantation but that homotransplantation of an organ, such as the kidney, was only temporarily successful, it invariably showing degenerative changes within a few days. Lexer, on the other hand, showed that he had succeeded in overcoming some of the biochemical reactions between his animals by a prolonged preliminary treatment of the host with tissues and blood serum taken from the donor.

Blood-vessels transplanted with proper precautions retain their vitality, become an integral part of the system and are believed to remain without extensive tissue metamorphosis.

But when parenchymatous organs with a more complicated physiological function, such as the kidney, the spleen and the thyroid, are transplanted the results as stated are different. They soon undergo autolytic changes and eventually become absorbed. This is known to be caused by biochemical reactions but may be due in part to injury incident to deficient venous drainage, and the technic about to be described is thought to minimize such injuries.

For an interval after an organ is transplanted, it remains in a state of vasomotor paralysis, and is apt to become overdistended with blood on account of insufficient venous drainage. Before appreciating the value of and employing end-to-end anastomosis I had found it necessary to split the kidney capsule in order to prevent parenchymatous destruction by hypertension.

In transplanting the kidney of one dog to the neck of another, one may unite the renal artery end to side to the carotid, but the stoma of the renal vein (Figs 1, 2 and 3) should be placed end-to-end with that of the external jugular. This I consider very important, because it creates immediate venous drainage for the transplant on account of the

* From the Laboratory of Experimental Surgery, New York University

negative pressure in the jugular. Such positive drainage does not occur if the anastomosis is lateral.

The Abderhalden method was used to seek the protective ferments in the blood which are brought into activity by the presence of a foreign transplant and which may induce its final autolysis.

The thyroid, on account of its accessibility and of the ease with which slight degenerative changes may be recognized, was chosen as the organ to transplant in this study. Furthermore, its venous drainage may be made adequate to prevent hypertension, thus minimizing parenchymatous changes due to physical injury (Fig 4).

Thyroid transplantation had been undertaken by Borst and Enderlem, Stich and others. Stich in his series of experiments had two successful autotransplants. Of my autotransplants, in two consecutive instances, the thyroid having been removed from the body and reimplanted in the same animal, the results were satisfactory, the thyroid tissue retaining its normal appearance and, apparently, its activity (Figs 5, 6 and 7).

In a series of homotransplants, although several of the animals lived for some time, the transplant invariably underwent degenerative changes with absorption (Figs 8 and 9). From a series of fourteen specimens so far obtained at the Laboratory of Experimental Surgery at the New York University, work conducted through the courtesy of Dr George D Stewart, it has been possible in eight instances to demonstrate the presence in the blood of a protective ferment capable of digesting suprarenal tissue. The significance of the demonstration is problematical but it may be an index of the susceptibility of the suprarenal body to insults occurring anywhere in the hæmopoietic system. However this may be, the Abderhalden reaction was positive in eight specimens from dogs operated upon as above described.

Tests with different substrata are being made to determine whether organs other than the suprarenal are sensitive to a thyroid transplant.

It is hoped that a way may be found, perhaps with the aid of the X-ray in controlling lymphatic absorption, to modify the biochemical differences which at present cause autolysis and prevent the use of transplants in applied surgery.

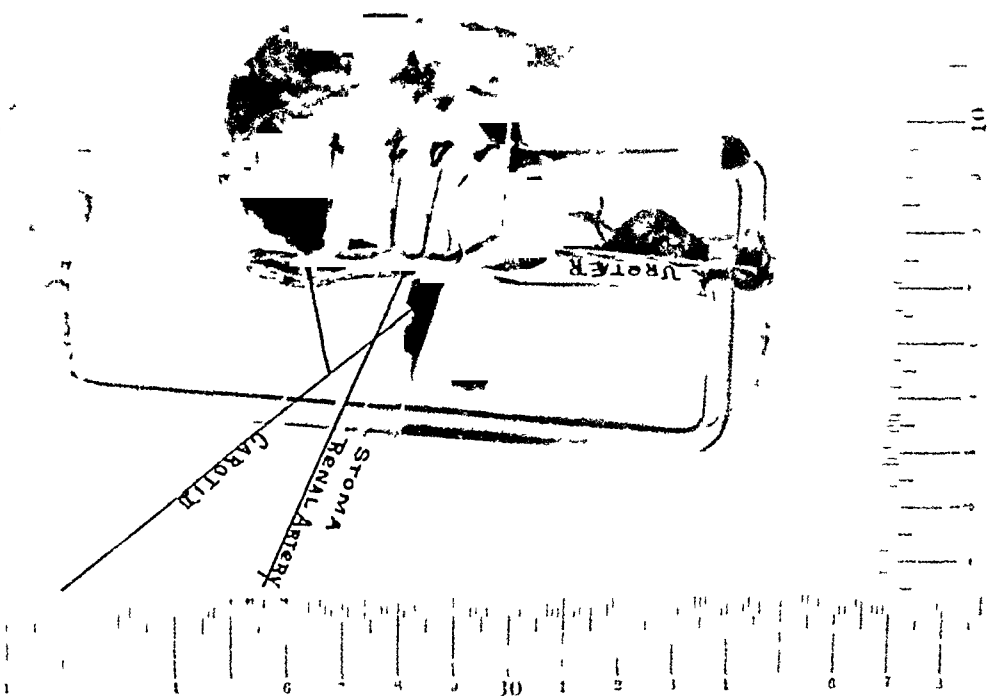


Fig 1—1c Homotransplant of kidney

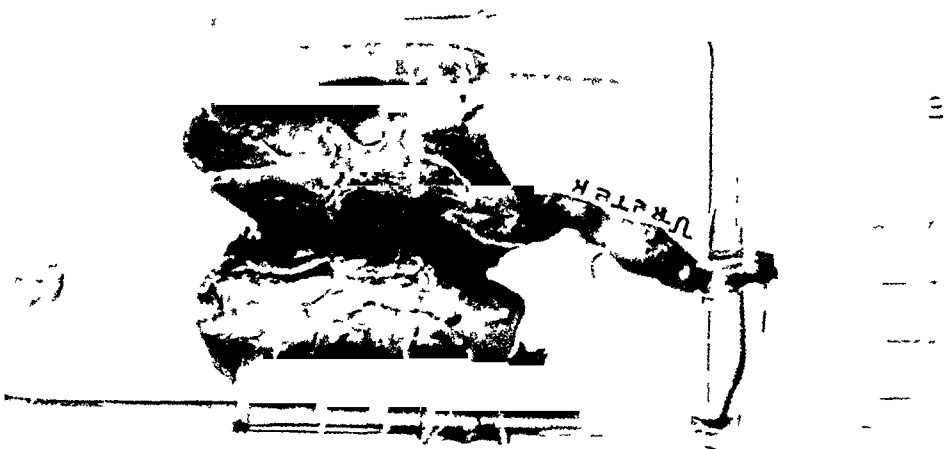


Fig 2—1b Homotransplant of kidney

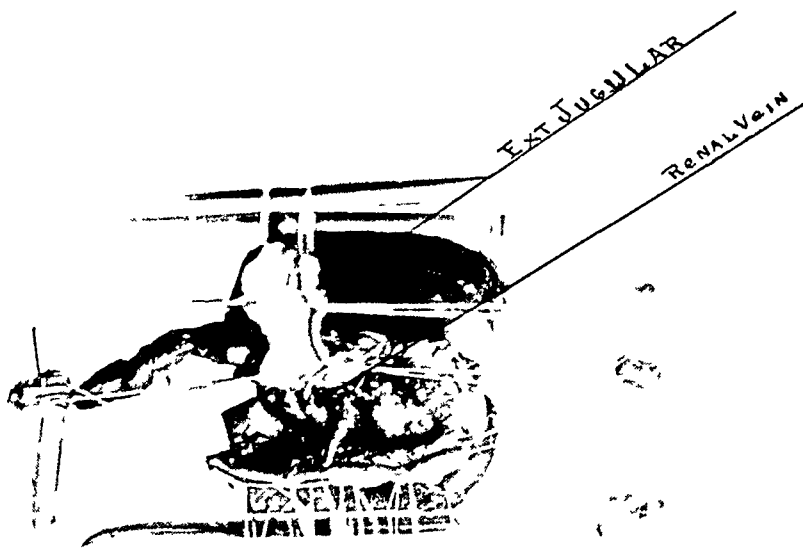


FIG 3-1a Dog 765 host Dog 685 donor Homotransplantation of kidney to neck Terminolateral anastomosis left renal to right carotid, end to end renal vein to external jugular Removed 8 days post-operative Note difference in calibre of vessels

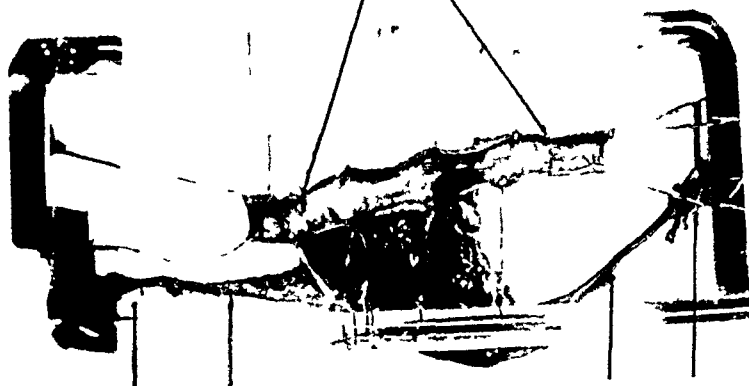


FIG 4—Dog 185 moribund black medium sized mongrel donor Dog 208 Irish terrier brown mongrel host Homotransplant of thyroid April 9 1914 Segment of left carotid of dog 185 interposed between severed ends of right carotid of dog 208 Inferior thyroid vein end to end with left external jugular, superior thyroid vein end to end with right internal jugular Dog died fifth day hemorrhage

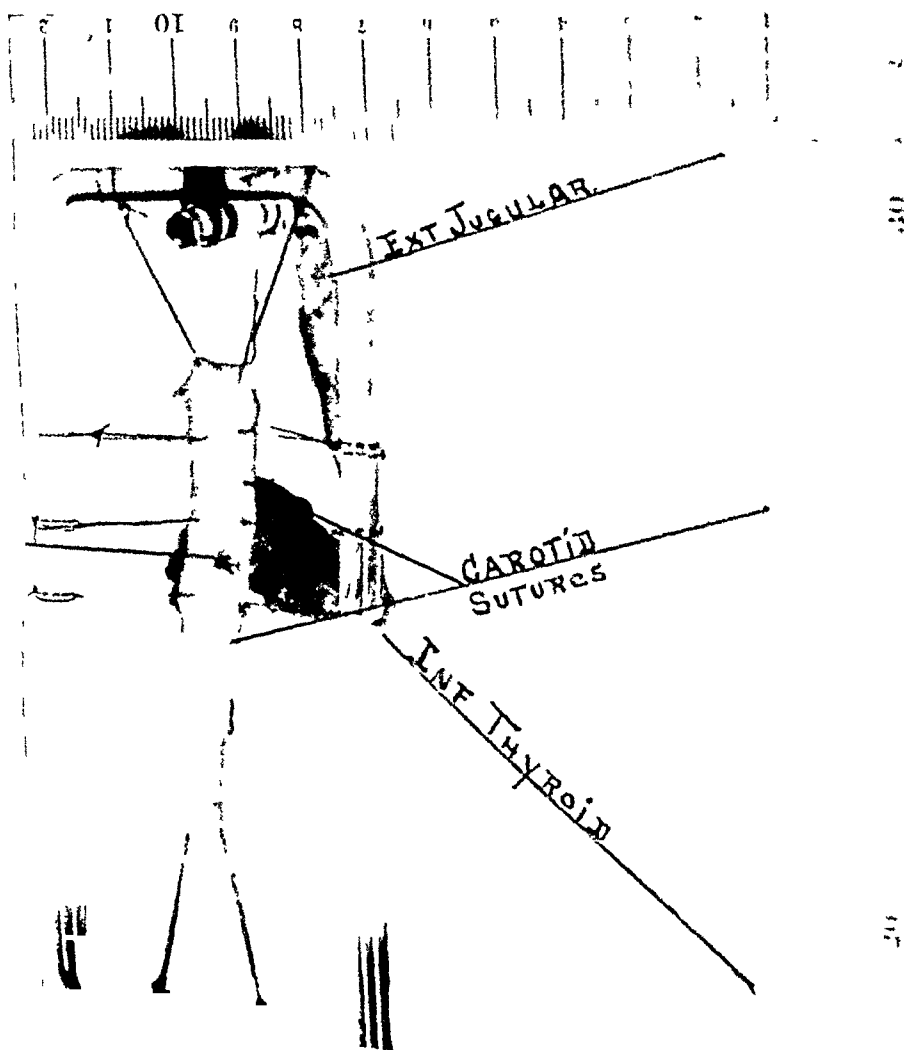


FIG 5—Dog 132 Autotransplantation of thyroid, February 26, 1914. Right thyroid with segment of carotid transplanted to left side. Inferior thyroid vein end to end with right external jugular. Removed twenty-three days after operation. Pathological report, normal gland.

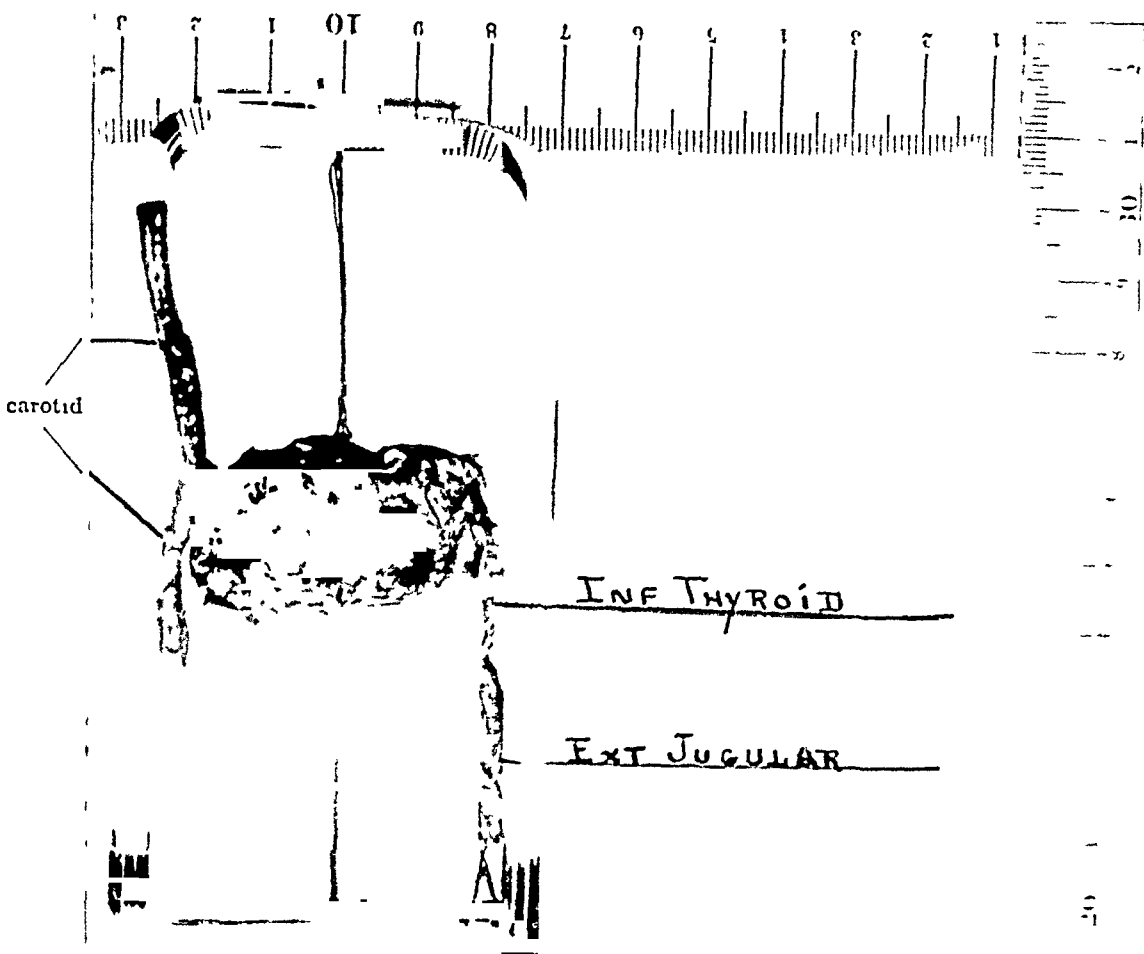


FIG 6—Dog 138 Autotransplant thyroid March 2 1914 Thyroid with segment of right carotid interposed between ends of severed left carotid, right inferior thyroid vein end to end with external jugular Death due to pericardial hemorrhage following aspiration of the left ventricle

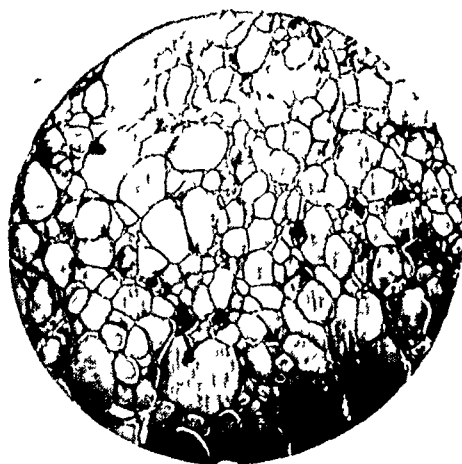


FIG 7—Dog 132 Autotransplantation of thyroid, specimen removed twenty-three days after operation

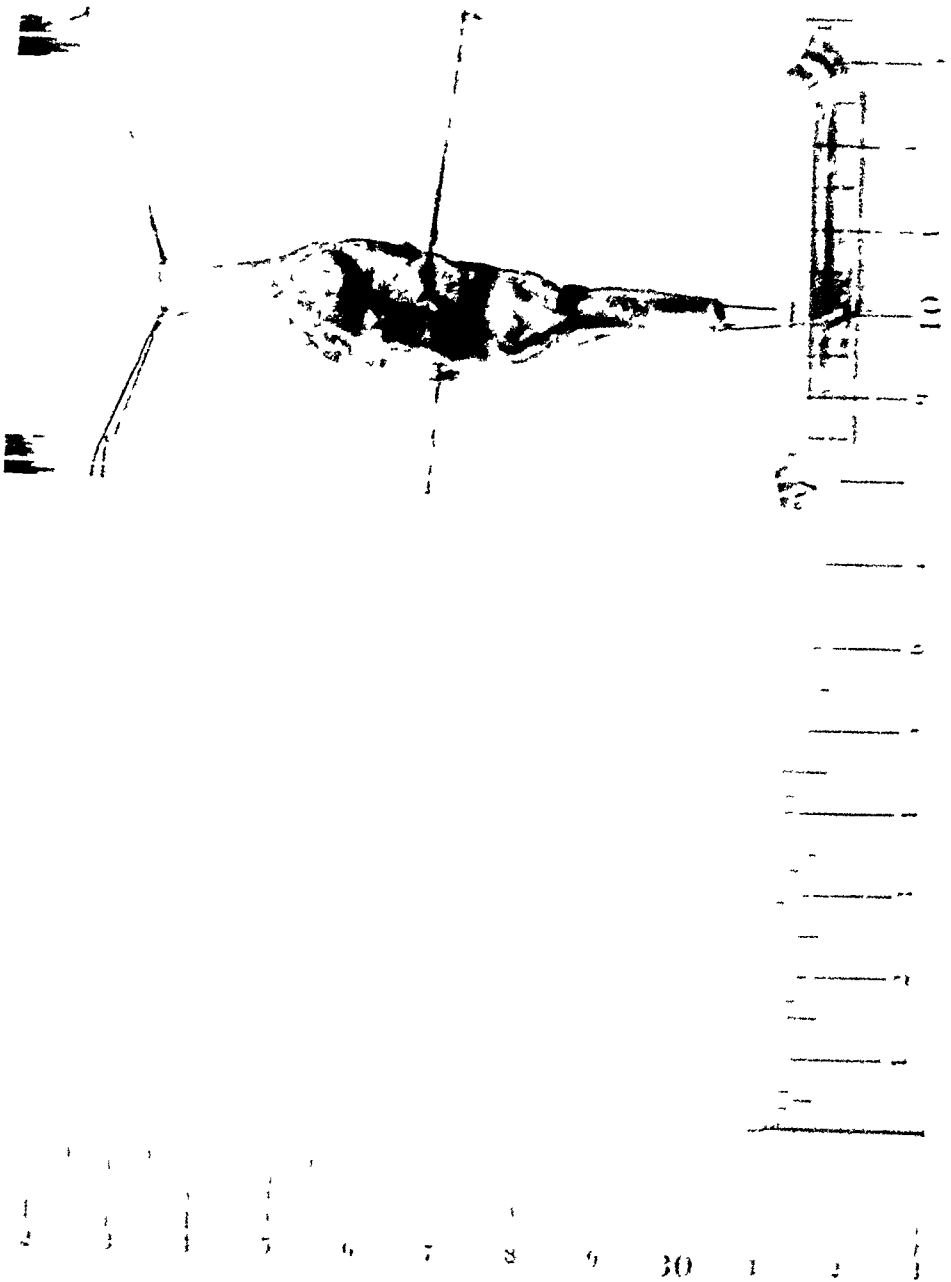


Fig 8—Dog 163, donor Dog 164, black and white coon, mongrel, host Homotransplant, March 19, 1914
Specimen removed April 23 Gland shows partial absorption Carotid has smooth intima No thrombosis

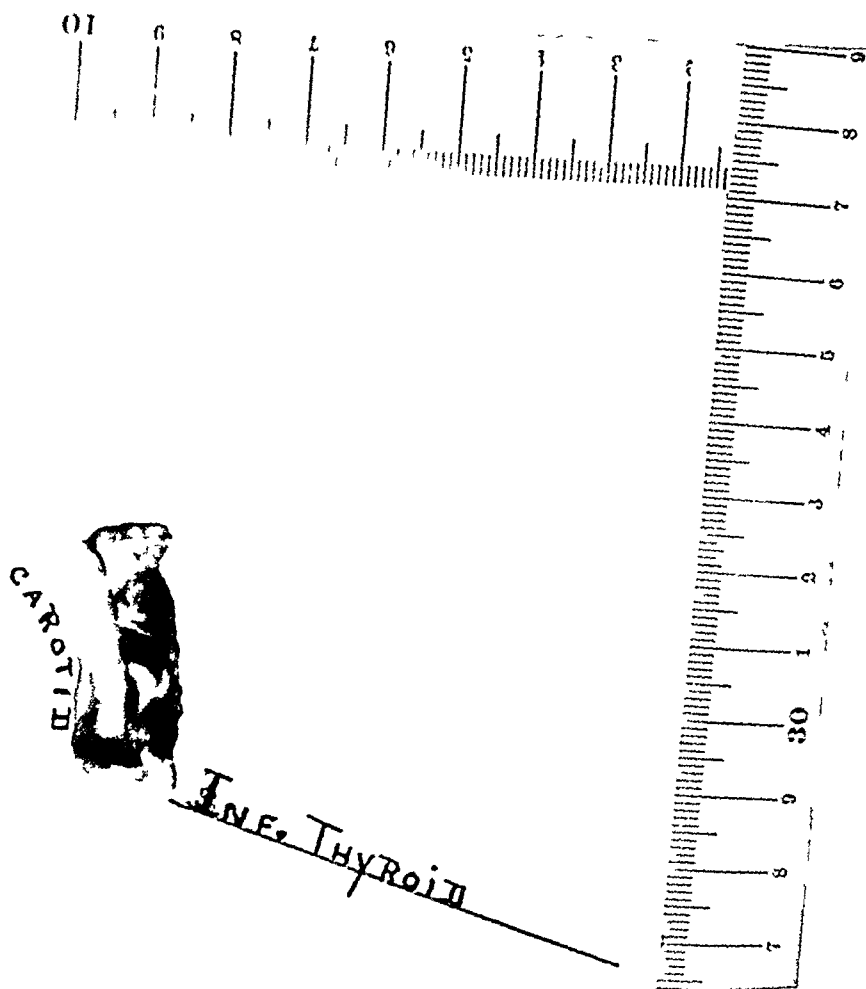


FIG 9—Dog 156 black and white bull donor Dog 157 mongrel host Homotransplant of thyroid March 16 1914 Microscopic report—partial necrosis, no thrombosis



FIG 10 —Exposure of thyroid body

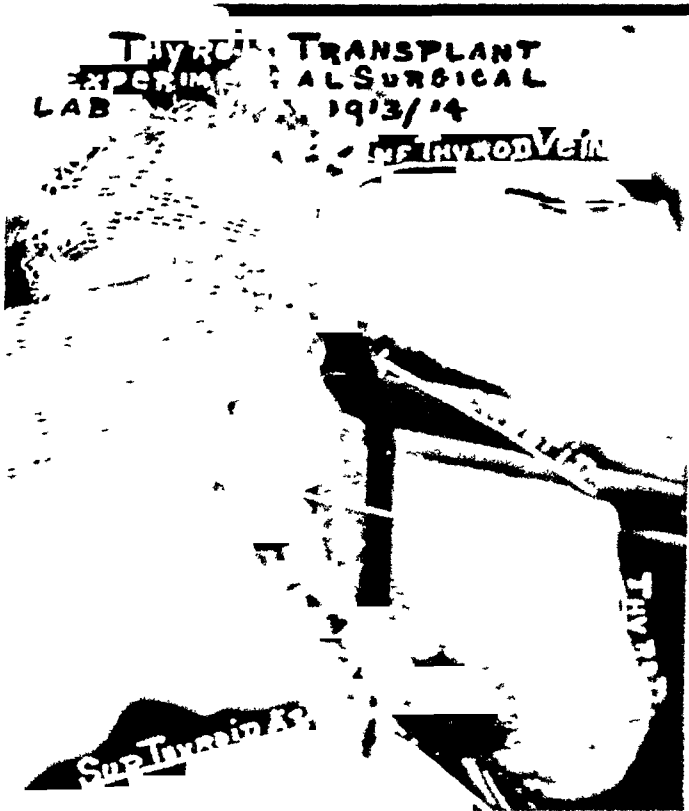


FIG 11 —Thyroid isolated and held by forceps

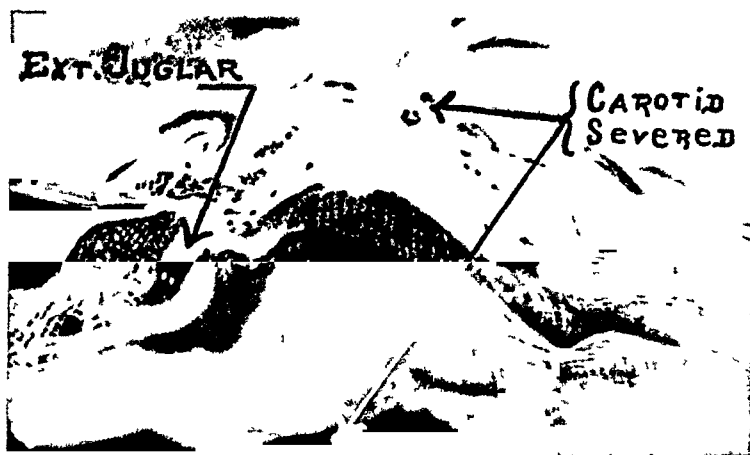


FIG 12 —Carotid and external jugular of host prepared for reception of transplant

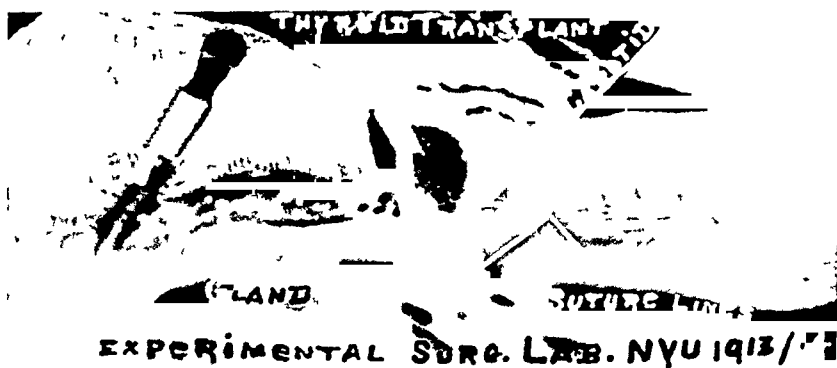


FIG 13 —Carotid suture completed Serrefines on thyroid vessels to prevent contamination of operative field

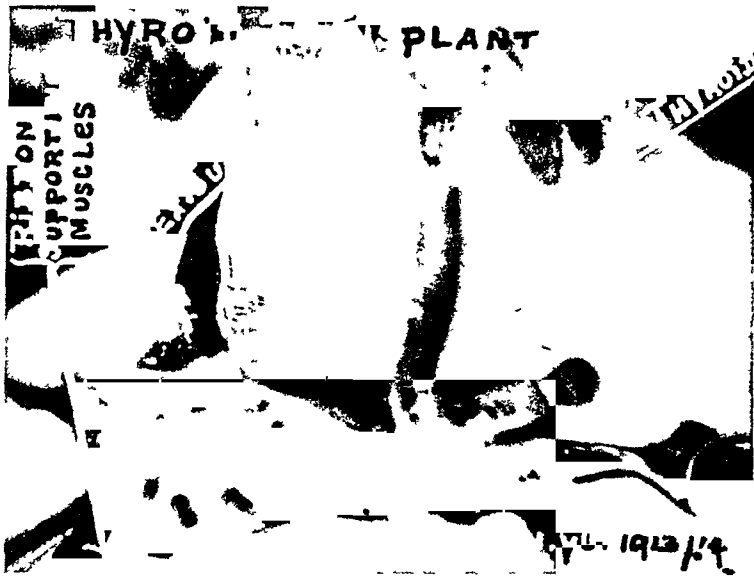


FIG 14 —Muscles in front of trachea tunneled and raised to admit transplant



FIG 15 —Suture of thyroid end-to-end with external jugular of opposite side, completing transplantation

SPINA BIFIDA

AN EXPERIMENTAL AND CLINICAL STUDY

BY NORMAN SHARPE, M.D.

OF NEW YORK

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SPINA BIFIDA, that curious congenital anomaly, has from time to time for many years engaged the attention of surgeons and embryologists. As yet the cause or causes of this condition are still unproved. The majority of embryologists unite in declaring that the chief factor, if not the only one, is a failure of the mesoblastic plates, in which the bony laminae of the spine are developed, to close over the spinal canal, thus leaving a gap or defect. This lack of development they regard as the primary causative factor of spina bifida. In opposition to this theory the suggestion has been advanced at different times, usually by surgeons, that the lack of development of the mesoblastic tissues is not the primary cause, but is secondary—is a result. They suggested that the primary, or inciting factor, is an abnormal accumulation of cerebrospinal fluid, in early fetal life, which by exerting pressure prevents the coming together of the mesoblastic plates containing the rudimentary laminae, in this manner producing a gap or defect in the spinal canal.

Several other theories have been advanced, none of which have received much support. They will be mentioned later.

The adherents of the first theory have advanced facts, marshalled arguments and presented the results of many experiments in their efforts to find the causative factor. But this is not yet definitely settled. The writer is one of those who believe that the second theory mentioned is the true one—that is, that the primary cause of spina bifida is the excessive pressure exerted by an abnormal amount of cerebrospinal fluid, this pressure preventing the closure of the bony laminae. And he believes that the results of later experiments are tending more and more strongly to throw the weight of evidence in favor of this theory.

It is proposed in this article to discuss the various theories of spina bifida, to give the results of experiments in connection with this subject carried out by the writer in the Laboratory of Experimental Surgery of New York University and Bellevue Hospital Medical College, besides a short review of the different varieties of spina bifida with their symptoms, diagnosis and treatment.

ETIOLOGY—In view of the difficulties confronting the experimenter, in that spina bifida originates in early fetal life, and that it is impossible to confirm on a human subject the results of experiments on the lower vertebrates, it is unlikely that the cause of this curious condition will be found directly through experiments

Of the various theories that have been put forward concerning the cause or causes of spina bifida, those which have received but slight support will be discussed first

Amniotic Adhesions—According to those who put forward this theory, the amnion becomes adherent to certain points along the dorsal ridge, and by traction prevents the mesoblastic tissues from crossing over and covering in the medullary groove. It is not explained how the amniotic bands selected the lumbosacral region, where by far the greater number of spinal defects are found. Besides, Dareste¹ and many others have, by chemical means, produced spina bifida in the embryos of amphibians, and these have no amnion. Mall² asserts that amniotic adhesions are the results of malformations, and not the cause of them.

Another theory advanced is that a *tumor* in the central canal of the cord, or in the spinal canal, in early fetal life, by its mere presence, prevented the laminae from coming together and closing the canal. Tumor masses, especially lipoma, are frequently found in the cleft in spina bifida occulta, but almost never in the other forms of spina bifida. Nor does this theory explain rhachischisis, and it has been given but slight support.

According to another theory, *kyphosis* of the spine, caused by exaggerated curvatures of the fetal vertebral column, so interferes with the development of the cord that spina bifida is the result. But as these exaggerated curvatures occur usually in the cervical and dorsal regions, it does not account for the majority of spina bifida being found in the lumbar and sacral regions. Neither does it explain spina bifida anterior, nor the fact that the cord in a great number of cases is fully developed.

The theory that has received the greatest support up to the present, especially from embryologists, is that spina bifida is due merely to lack of development of the mesoblastic tissues that cover in the medullary groove.

The Committee on Spina Bifida of the London Clinical Society in 1885³ stated "The theory which best explains the pathological anatomy of spina bifida is that which assumes a primary defect of development of the mesoblast from which the structures closing in the vertebral furrow are developed. After the closure of the neural furrow it would appear that the processes of mesoblast which subsequently insinuate themselves between the primitive spinal cord and

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its overlying epiblast are formed in an insufficient degree to meet and combine, or that these processes, should they meet, are not formed in sufficient proportion to serve as a basis, from which the various structures subsequently to be produced over the spinal cord can be developed" This theory, in the main, is supported by embryologists, being merely modified in some respects by the results of experimentation Bailey and Miller⁴ say that "at the present time it is generally agreed that spina bifida is closely related to defective closure of the neural tube, although the exact nature of this relation is not known"

Hertwig⁵ showed that if the eggs of axolotl are treated with a 0.7 per cent solution of sodium chloride, all the embryos will have spina bifida, and Morgan and Tsuda,⁶ by putting frog embryos in the early stages into a 0.6 per cent solution of sodium chloride, produced spina bifida

Recently some embryologists are abandoning the idea that spina bifida is due to lack of development of the mesoblast, to a germinal defect They state that these experiments indicate that malformations are due to external influences, and not to defects in the germ itself Mall says that malformations are not due to poisons in the maternal blood (corresponding to chemicals used in experiments) or to germinal defects, but to faulty implantation of the ovum in the uterine mucosa, or to an unhealthy condition of the mucosa

In opposition to these theories, from time to time the opinion was advanced, mostly by surgeons, that the primary cause of spina bifida was some disorder of the cerebrospinal fluid circulation But owing to the former scanty knowledge of the formation and outgo of this fluid, progress in this direction was hampered Recent investigations in this field, however, have opened up this subject widely We now know that the cerebrospinal fluid is a secretion, and not an exudation, and that it is formed by the choroid plexuses of the lateral ventricles The remarkable work of Dandy⁷ in stopping the outflow of fluid from the ventricles by plugging the iter, and injecting solutions of phenolsulphone-phthalein into the ventricles, and in other cases into the subarachnoid space, and timing its appearance in the urine, shows that the cerebrospinal fluid is removed or absorbed almost entirely by the blood-vessels of the subarachnoid space, to a very slight degree by the lymphatics, and practically not at all by the ventricles

The writer believes that the vast majority, if not all, of spina bifidæ are caused by the pressure exerted by an excessive secretion of cerebrospinal fluid, or, what is more probable, some obstruction to its normal outflow. This pressure, acting in early fetal life at different stages of development, prevents the closure at certain points of the bony canal. This theory is applicable to all forms of spina bifida, and has the support of much clinical evidence This theory should not be confused with the opinion expressed by Forster many years ago, that spina bifida was due to dropsy of the central canal of the cord which forced out a pro-

trusion through the posterior columns of the cord, causing atrophy of the nerve fibres. Except for syringomyelocoele, which forms only one or two per cent. of all cases, this is now held to be incorrect, as in the great majority of cases the central canal is normal, and in many the nerve fibres are intact.

What are the facts on which rests the theory of intradural pressure? We know that the cord is derived from the epiblast, as is also the skin. These two structures, the cord and skin, remain adherent, until the mesoblastic structures (meninges and bone) insinuate themselves between the cord and skin, which occurs normally in the third month of fetal life.

The vertebrae are developed from four centres of ossification, one for each lamina and one for each half of the body. The laminae meet in the median line, closing the spinal canal first in the dorsal region, then in the cervical, and last in the lumbosacral regions. The choroid plexuses of the cerebral ventricles are formed by the second month of fetal life, so that the cerebrospinal space contains fluid before the cord and skin are separated by the mesoblast, which should occur in the third month. Therefore, any undue pressure in the spinal canal at this time will prevent the closure at some point of the canal, and it is clear that this point will be the region of latest closure, the lumbosacral region. This is the region favored by spina bifida, in which, according to observations, 86 per cent. of all spina bifida are found, while $9\frac{1}{2}$ per cent. are found in the cervical, and $4\frac{1}{2}$ per cent. in the dorsal, the region of earliest closure of the canal.

Even in total rhachischisis with only rudimentary development of the cord and brain, the ventricles and choroid plexuses are fully developed, showing that fluid has been secreted, and excessive secretion with distention at this early stage will account for the rudimentary brain and cord and its open condition.

What are the clinical facts that support the theory of undue subdural fluid pressure, or that oppose the theory of germinal defects or lack of development? As against the theory of lack of development in the mesoblast, we have those cases in which after the protrusion is excised, thus removing pressure, the rudimentary laminae will take on new growth, as reported by Patterson.⁸

Supporters of the germinal defect theory assert that the increased amount of fluid present, as shown by the hydrocephalus that so commonly accompanies spina bifida, is a secondary condition, a result of the open canal. This is disproved by those cases where there is no bony defect, but the protrusion is forced out through the intervertebral

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ligaments Also, hydrocephalus does not follow craniotomies or decompression operations, done on very young infants, and yet hydrocephalus will very often develop in children with spina bifida *after* the defect is closed My own opinion is that the conditions causing the excess of fluid in fetal life still exist after birth, but much of this fluid is removed by the rich vascularization to be seen around the sac, the dura being absent or open in most of these cases Where the dura is not open, or where hydrocephalus does not follow the operation, is explained by renewed function of the vessels of the subarachnoid space The series of experiments undertaken by the writer were not done with the expectation of discovering the cause of spina bifida, but rather with the view of discovering evidence for or against the theory of undue intradural pressure Naturally, it is admitted that producing spina bifida or a condition analogous to it, on a living animal by means of pressure, is not positive proof that spina bifida in the human being is produced by this means, any more than producing spina bifida in frog embryos by treatment with sodium chloride solutions is proof that spina bifida in the human being is caused by chemical stimulation Experimentation along this line can but add corroborative evidence to clinical facts Very young dogs were selected and lumbar laminectomies were done, only the superficial tissues being sutured over the defect Large areas of the skull were removed and wounds allowed to heal Then pressure was applied to the head, maintained and gradually increased It was not expected that the external pressure alone would be sufficient to cause a protrusion in the lumbar defect, as even in very young dogs the dura is rather inelastic, but it was hoped that the irritation of the pressure on the cortex would cause an increase in secretion of the cerebrospinal fluid, or, what was equally as efficient, an obstruction to its normal outflow That this did happen in some of the subjects was shown by the development of œdema of the optic nerve head, which gradually progressed to choked discs with dilated retinal veins, as noted by the ophthalmoscope This was not due to the external pressure alone, as other dogs, on which as great or greater pressure was used, showed no œdema of the discs Although the pressure in no case was sufficient to paralyze the dogs, yet in two of them, the one with the choked discs and one other, autopsy showed marked bulging of the spinal membranes through the laminectomy cleft

The same procedure was carried out on one guinea-pig and two rabbits, with this difference, that injection of salt solution was used to create the pressure, instead of external pressure over a craniotomy wound of the head Rabbits and guinea-pigs were selected because of

their less strong and dense meninges. The technic was the same in all three cases, and the same results were secured. The laminae of the last two lumbar and of the first and second sacral vertebrae were removed, exposing the dura. Then the laminae of the last cervical vertebra was removed and by means of a syringe with hollow needle two drachms of salt solution were injected under the membranes. This increase of intradural pressure caused a marked protrusion of the membranes through the cleft in the lumbosacral region. Fig 1 shows the artificial spina bifida produced in the lumbosacral region of a rabbit and Fig 2 is a diagrammatic view of the same condition. Naturally these experiments do not prove the cause of spina bifida. They merely show that intradural pressure, whether applied over a period of weeks, as in the case of the dog, or for a few minutes, as in the case of the rabbit, will cause a protrusion of the spinal membranes if there be a gap or defect in the bony canal. They are evidence, not that spina bifida is caused in this manner, but that it could be. In the writer's opinion, further advances along this line of investigation will be made as more facts are uncovered concerning the disorders to which the cerebrospinal fluid circulation is subject.

VARIETIES OF SPINA BIFIDA —*Rhachischisis* — This, the most extreme form, differs from spina bifida proper, in that in it the cord is spread out and exposed and the central canal is open, while in spina bifida proper the cord is covered and the central canal does not open on to the surface. Rhachischisis may be either total or partial.

In total rhachischisis, the pressure being exerted very early in intra-uterine life, the entire medullary groove remains open, so that the entire canal is uncovered, the skin, bony arches and meninges are absent. The lining of the central canal of the cord is open and the layer of pia containing blood-vessels is exposed. Anacephalus sometimes accompanies this condition, so that from the forehead to the coccyx the spinal canal is simply a trough containing the mass of undeveloped brain and cord. The spinal column is usually disposed in abnormal curves, especially in the dorsal and cervical regions. Thorndike,⁹ who has studied this condition, presents several typical and interesting specimens of this character.

In partial rhachischisis or, as it is termed by some, myelocoele, only a part of the spine and cord are involved, usually only three to five vertebrae. At the site of the defect, the cord with its central canal is open, and the spread-out layers of pia carrying blood-vessels gives to this area, which Von Recklinghausen has called the "area medullovasculosa," the appearance of mucous membrane. In milder forms of partial

rhachischisis the defect is covered by a thin membrane, the central canal opening into the surface at the upper and lower ends of the gap, with leakage of cerebrospinal fluid

Both total and partial rhachischisis are easily recognized. They are of little interest from an applied surgical point of view, as the infants are usually stillborn, or at best live but a few hours or days. The case of partial rhachischisis with recovery reported by Small¹⁰ is a doubtful one, as nothing was said as to the condition of the cord or that the central canal opened into the surface

Myelomeningocele—This is the most frequent type of spina bifida, occurring in 70 to 80 per cent of all cases. In this type of spina bifida the cord is almost fully formed, but the abnormal pressure prevented the crossing over of the mesoblastic tissues, so that the cord and skin are not entirely separated. Hence, when the skin is forced outward to form the sac wall, the adherent cord and roots are drawn out of the canal. Myelomeningocele is commonly found in the lumbar region, infrequently in the dorsal, and rarely in the cervical. Fig 3 is a myelomeningocele at the lumbosacral junction, accompanied by mild hydrocephalus. At operation eight roots of the cauda equina were found adherent to the sac wall. There is a fairly large bony defect, and these tumors are always sessile. The base of the sac is composed of normal skin, but the apex is covered by a membrane formed by the fusion of epithelium with the arachnoid and pia. This membrane may be quite strong, but is usually thin, and contains small ulcerating areas, through which cerebrospinal fluid "sweats." At the junction of this membrane with the skin base, there is a ring of connective tissue containing plexuses of blood-vessels and at times the rudimentary laminæ. The protrusion is usually unilocular, but occasionally small cavities are found communicating with the main sac. The summit of the sac is often marked by a dimple at the point where the cord is attached, or if the defect is in the lower lumbar region, by a broad furrow marking the attachment of the conus terminalis. Due to the traction of the adherent cord and roots, or to lessened intradural pressure, the entire summit of the protrusion is often cup-shaped. The dura is absent in the defect, extending only to the membranous-skin junction, or even only to the margins of the bone defect. Rarely myelomeningocele is unaccompanied by nerve disturbances, but the following are more often found. Partial paralysis of the legs or complete paraplegia, club-foot, trophic ulcers, incomplete control of the sphincters and often incontinence.

The diagnosis of spina bifida is, as a rule, not difficult, if the following points are kept in mind—that the protrusion is congenital and is in

the median line, that there is fluctuation of the sac, and pressure causes a decrease in size with bulging of the fontanelle, that the tumor becomes tense on coughing or crying; that the cleft in the bone may be felt, that the tumor is translucent

Spina bifida in the lumbosacral region must be differentiated from the following conditions Lipoma, post-rectal dermoid, and ischiatic hernia The most common error is made in regard to lipoma Lipoma often overlies a small spina bifida and operation to remove a supposedly simple lipoma may result disastrously for the patient (Bland Sutton¹¹)

To differentiate between the different varieties of spina bifida is more difficult In making a diagnosis of myelomeningocele we rely upon the following points Myelomeningocele is the most common form, occurring in 70 to 80 per cent, there is usually a fairly large bony cleft which can be felt; the tumor is sessile and has a membranous apex, which is dimpled or furrowed at the point of attachment of the cord or roots, transillumination will usually show the extruded cord and roots, but this sign often fails, owing to irregularities in the sac wall, and, finally, the evidence of nerve involvement of the lower extremities, which is very common in myelomeningocele

Untreated, practically all these children will die, very few of them reaching the age of five years Operated upon, the prognosis depends upon the general condition of the child, the condition of the sac and the amount of nerve involvement There have been many cases of cure reported, most of them in young infants

Spinal Meningocele—Meningocele is found in from eight to twelve per cent of all cases It is commonly found in the lumbosacral region, infrequently in the cervical and rarely in the dorsal regions The bony gap is usually a small one, involving but one or two arches Occasionally there is no bony defect found, the meninges being forced out through the intervertebral ligaments The protrusion is at times pedunculated and covered with normal skin (Fig 4), though sometimes the apex contains a small membranous area The inner sac wall is lined entirely with dura and contains only fluid, the cord and nerve roots not lying in the sac, but occupying their normal positions in the canal

Meningocele, the simplest form of spina bifida, can be explained in this manner The abnormal accumulation of fluid does not occur until some time in the third month of fetal life, after the separation of cord and skin by the mesoblastic tissues The pressure finds its outlet at the point where solid closure is least advanced, the lumbosacral region When the protrusion has a very slender pedicle, the opening into the canal may be obliterated by fibrous tissue

The diagnosis of spinal meningocele rests on the following. The sac has a fairly narrow base, but rarely pedunculated. It is usually covered entirely by normal skin. Transillumination shows the absence of nerve elements. Nerve supply of the lower extremities is entirely, or almost entirely, free from involvement.

The prognosis is good, if operation is performed, though frequently excision of the sac is followed by enlargement of the head. Untreated, the prognosis is bad, for, except in those few cases where the opening into the canal is occluded, the tumor increases in size, with rupture and septic meningitis as the result.

Syringomyelocele.—This very rare form of spina bifida is due to the pressure exerted by an abnormal amount of cerebrospinal fluid in the central canal of the cord, the pressure preventing the closure of the bony arches and forcing the posterior half of the cord out through the bony defect. Thus the inner sac wall is formed from the spread-out cord, with attenuation and atrophy of the nerve elements. Syringomyelocele is found usually in the lumbar region, rarely in the cervical. As the central canal of the cord in the lumbar region remains quite large almost until birth, a collection of fluid here with pressure readily accounts for the protrusion being found in this region.

In making a differential diagnosis of syringomyelocele from the other forms of spina bifida, its rarity must be taken into account. It occurs only in one to two per cent of all cases. In translucency it resembles meningocele, as the attenuated nerve elements cast little shadow. In appearance and symptoms of nerve involvement, it closely resembles myelomeningocele. However, as operation is the treatment for both types, a positive diagnosis before the sac is opened is not of great importance. The prognosis of syringomyelocele if untreated is the same as for myelomeningocele, and with operation it is not as favorable as that for myelomeningocele.

Anterior Spina Bifida.—In this rare form, the protrusion extends forward between the two halves of the bodies of the vertebrae, which, as has been said, develop from two centres of ossification, or through an intervertebral foramen. In this type the sac is usually found in the abdomen or pelvis, and the sacrum is the part of the spinal column most often involved. As a rule, there is no posterior deformity of the arches, though Wilhard¹² reports a case in which there was both an anterior and posterior protrusion. Spina bifida anterior is almost entirely confined to females, though Grossman reports one in a male infant of ten months. It is a pure meningocele, though pressure or irritation may cause some nerve disturbances, usually of the motor nerves.

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The diagnosis is exceedingly difficult unless there is also a posterior protrusion, or there is an accompanying nerve involvement, such as club-foot or paraparesis. The sac usually reaches a much greater size than could occur posteriorly without rupture, and it is usually mistaken for sarcoma or ovarian cyst. The presence of symptoms of nerve involvement of the lower extremities should prevent such errors. The prognosis is uniformly bad, as all cases operated upon reported to date have died. In the majority of cases it would have been most difficult to have successfully closed the opening into the spinal canal.

Spina Bifida Occulta —In this curious and interesting form of spina bifida there is a cleft in the bony arches, but no protrusion. The absence of protrusion is accounted for by lessened intradural pressure or by rupture of the sac in early fetal life, the point of rupture being marked by a scar which is often found in the skin over the defect. The tissues over the defect are often the seat of a diffuse non-capsulated lipomatous growth, or the skin overlying it is wrinkled and pigmented and surmounted by a tuft of coarse hair. The presence of lipoma or of hypertrichosis is equally pathognomonic of spina bifida occulta. Occasionally, however, the overlying tissues are free of defects and the skin is normal and free of scars or hair. Very often a lipoma or dermoid lies in the bony cleft or in the spinal canal, connected by fibrous bands with another tumor outside the canal. Again, adhesions are often found connecting the skin and cord and roots, showing an imperfect separation of the two in fetal life. Nerve involvement is usually absent at birth, but with the growth of the child, the ascent of the cord drags upon the adhesions in the cleft, and more or less severe symptoms of nerve disturbances make their appearance in the lower extremities. These are, weakness of the legs, distortion of the feet, coldness and discoloration of legs, trophic ulcers and disturbances of the sphincters.

The diagnosis depends on the symptoms of nerve involvement, presence of lipomatous tissue or hypertrichosis over the lower spine, and on the X-ray.

The patient in Fig 5 was a sturdy sailor twenty-four years of age, who complained only of tingling in the hands and fingers when the arms were hanging loosely. There were areas of hypæsthesia and hypalgesia on outer side of the left upper arm. The skin over the defect was normal, no hypertrichosis or lipoma was present. The X-ray (Fig 6) showed a defect extending from the fifth cervical to the sixth dorsal vertebra (the arrows mark the upper and lower limits of the defect). There will be noticed in this picture and also in the other skiagraphs a spreading or broadening of all parts of the defective vertebræ, which I

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ascribe to the effects of the intradural pressure in the developmental stage Dr B C Darling, who has made a study of this condition from a skiagrapher's point of view, tells me he finds this "broadening" in all cases

The child of four and a half years shown in Fig 7 had spina bifida occulta in the lumbosacral region, with partial paraplegia and incontinence of urine from birth No protrusion in back or hypertrichosis was present, but a diffuse lipoma over the sacral region The X-rays (Fig 8) show absence of the laminæ of the fifth lumbar vertebra and the upper segments of the sacrum, with distortion of the sacrum and the pelvis Fig 9 is the skiagraph of the pelvis of a girl of nine years of age who had partial paralysis of the right leg with a congenital dislocation of the right hip and a dilated bladder with incontinence There was a tuft of hair an inch long over the fifth lumbar vertebra, but no protrusion Fig 10 shows the defect in the laminæ better, extending from the fifth lumbar vertebra to the fourth sacral segment, a case of spina bifida occulta

It was formerly believed that congenital dislocation of the hip, club-foot, hare-lip, cleft palate and the other deformities that sometimes accompany spina bifida, were due to general lack of development, and proving that spina bifida was but a germinal defect But club-foot and dislocation of the hip, as in the above case, are readily seen to be due to the defective nerve supply They are consequences of spina bifida and not germinal defects As for hare-lip and cleft palate, we know that cyclopia and non-union of the branchial clefts can be artificially produced in the lower vertebrates by interfering with their normal course of development, by chemical agents And as the normal union of the frontonasal and maxillary processes depends on a normal development of the forebrain region, the pressure of an abnormal accumulation of cerebrospinal fluid in fetal life will account for these defects

TREATMENT—The treatment of spina bifida other than by operative interference may be dismissed in a few words Ligation of the base of the sac, acupuncture and aspiration only hasten the rupture of the sac, and are no longer used Injection of the protrusion with Morton's fluid, a solution of iodine, once widely used, usually results in death Even if shrinkage of the sac followed the injection, if any nerve elements were present in the sac, further compression of these occurred However, some surgeons still advocate the use of Morton's fluid Open operation is coming more and more to be recognized as the rational and best method of treatment By many surgeons operation is strictly lim-

ited to selected and favorable cases, without much nerve involvement. But in view of the fact that over 90 per cent. of these children will die in the first year alone, if not relieved, and that many cases of recovery following operation on apparently hopeless cases have been reported, the scope of operative interference should be greatly extended. The writer believes that the only contra-indications to operation are a bony defect so large that it could not possibly be repaired, and a condition of absolute paraplegia and complete loss of sphincteric control. Age is of no importance, as many cases of recovery are reported in very young infants, following operation.

A description of the operative technic and the after-treatment will be omitted here, as the writer has described them in detail elsewhere (Johnson's *Operative Therapeutics*, vol. III). The following series of cases, which were operated upon in conjunction with Dr. William Sharpe, in the Neurological Surgical Department of the N. Y. Polyclinic Hospital, were selected for reporting as representing different types of spina bifida. They include myelomeningocele, meningocele and spina bifida occulta. I have not yet met with syringomyelocele nor spina bifida anterior.

It is interesting to note that in the majority of them there was an associated hydrocephalus.

CASE I—*Spinal Meningocele with Hydrocephalus*—P. M., age three months, full-term child, normal delivery. At birth large head noticeable, also lump on back size of English walnut, which at times became much smaller, leaving only a wrinkled pad of skin. Examination at three months showed head quite large and broad, with bulging forehead, and fontanelles tense. There was a protrusion the size of a small grape-fruit over the sacral region two inches from the anus. Definite weakness of the legs. Child rather stuporous, some difficulty in breathing.

Operation—Thin-walled meningocele, no cord elements in sac. Inner sac wall sutured at margins of cleft, and fascia drawn over and sutured with three layers of chromic gut. Skin sutures of silk. Right ventricle was tapped through a small opening and four strands of No. 2 catgut were passed into ventricle and anchored under scalp for drainage. At conclusion of operation child was in fair condition. Temperature rose to 107° in twelve hours and child died. In this case, we probably attempted to do too much, but on account of the difficulty in respiration, we thought it unwise to defer the tapping of the ventricle to a later time.

CASE II—*Myelomeningocele with Hydrocephalus*—Baby N., age five months, first baby, full term, normal delivery. Small



FIG 1 —Artificial spina bifida in rabbit

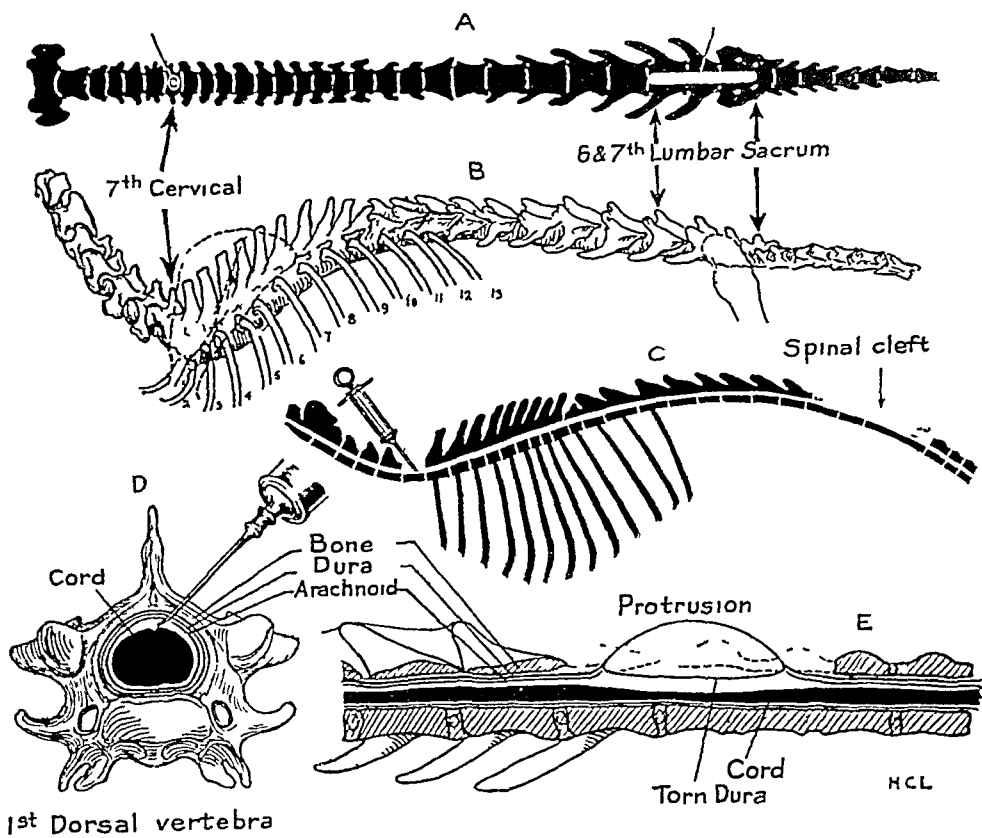


FIG 2 —Diagrammatic scheme of artificial spina bifida



FIG 3 —Case II Myelomeningocele with mild hydrocephalus



FIG 4 —Case III Spinal meningocele with hydrocephalus



FIG 5 —Spina bifida occulta in cervicodorsal region



FIG 6 —Skilograph of Fig 5 (skilograph by Dr B C Darling)



FIG 7 —Spina bifida occulta in lumbosacral region (after operation) A line of incision



FIG 8 —Skiagraph of Fig 7 (skiagraph by Dr B C Darling)



FIG 9 —Spina bifida occulta in lumbosacral region with congenital dislocation of right hip
(Permission of Dr Royal Whitman, skiagraph by Dr B C Darling)



FIG 10 —Another view of sacrum in Fig 9



FIG 11 —Case II Myelomeningocele with hydrocephalus (after operation) Fig 3 is same case before operation



FIG 12 —Case IV Myelomeningocele (after operation)

lump noticed at birth in lower lumbar region. This gradually increased in size. Legs apparently not affected. Examination at five months showed a well-nourished child with somewhat weak legs, but no definite paralysis. Slight weakness of rectal sphincter. In the lumbosacral region there was a reddish, thin-walled cystic tumor the size of a grape-fruit, with a wide base, three inches in diameter. Sac wall very thin at several points, rupture appearing imminent. Head was mildly hydrocephalic with high towering forehead (Fig 3).

Operation—A curvilinear incision was made along the left base of the sac. The lowered head of the child prevented the escape of cerebrospinal fluid other than that contained in the sac. Bone defect small, $2\frac{1}{2}$ cm. in length. Eight roots of the cauda equina were found adherent to the sac wall. These were dissected free and returned to the canal which at this point was very shallow. The dura extending only to the bone margin, the canal was perforce left open. The vertebral aponeurosis was dissected up on each side and sutured over the cleft with several rows of chromic gut, skin sutures of silk. A rubber tissue drain was inserted. Child in good condition after operation.

Several days after operation several small trophic ulcers appeared on inner sides of thighs and on left big toe, probably due to operative injury to nerves in sac wall. They healed in a short time. At present, one year after operation, child is in good condition, the legs are strong and there has been no further enlargement of the head (Fig 11).

CASE III—Meningocele with Mild Hydrocephalus—J M, age four months, full-term child, instrumental delivery. Congenital protrusion the size of a lemon in lumbosacral region. No paralysis of lower extremities. Head apparently normal. Examination at four months showed a fairly well-nourished child with a thick, reddened tumor, orange-sized, over the fourth and fifth lumbar vertebrae. Tumor cystic in places. No paralyses, no sphincteric disturbances. Head slightly enlarged, but scalp vessels were greatly dilated and fontanelles tense (see Fig 4).

Operation—Straight incision in median line. Cord and nerve roots not involved in sac. Small laminal defect, through which a small cyst of arachnoid protruded (sac within sac). Base of sac ligated and overlaid by flaps from surrounding fasciæ, which was sutured with chromic gut, skin sutures of silk. Right ventricle tapped through the right margin of the anterior fontanelle. Much fluid escaped. Two weeks later the head had slightly enlarged, with fontanelles tense. Right ventricle was again tapped and ten days later this tapping was repeated. At present writing the child is in good condition. The head is still large, but not enlarging.

CASE IV—*Myelomeningocele with Mild Hydrocephalus*—

A H, age two weeks, full-term, normal delivery. Congenital cherry-sized swelling in lumbosacral region. Did not move the legs freely. Head not enlarged. Examination showed a well-nourished child with a reddened, tense swelling, orange-sized, over the first sacral vertebra. Sac wall very thin, with two yellowish excoriations at the summit. Head not much enlarged, but fontanelles very tense. Some weakness of right leg. Incontinence of urine and fæces.

Operation—S-shaped incision opening sac. A number of cauda roots were found adherent to sac wall, dissected free and returned to the canal. Small bony defect in the first sacral segment. Inner sac wall sutured in the cleft and overlaid by flaps cut from the vertebral aponeurosis which were drawn one under the other, as in the repair of umbilical hernia. Skin sutures of silk. Superficial infection of wound from the dribbling urine and fæces. Daily dressings. Child discharged three weeks later in good condition. Five months later there was no paralysis, no incontinence, head slightly enlarged. A year later child was in excellent condition, no paralysis and head not enlarged (see Fig 12).

CASE V—*Myelomeningocele with Almost Complete Paraplegia*—G M, age one and a half years, eight-months child, normal delivery. Tumor in lumbosacral region size of walnut which ruptured at birth and discharged fluid for three days. Legs weak. Tumor gradually increased to orange size and was treated by caustics which caused it to shrink somewhat, with intense induration. Legs gradually became almost completely paralyzed, with incontinence of urine and fæces. Examination showed a fairly well-nourished child with paralysis of both legs and loss of sphincteric control of bladder and rectum. In the lumbosacral region was a reddened indurated mass the size of an orange. In the centre was a thinned area one and a half inches in diameter. No hydrocephalus.

Operation—Straight vertical incision through centre of mass. Many nerve roots found bound in the scar tissue. Bony defect in the laminae of the three lower lumbar vertebrae two and one-half inches long. Nerve roots were dissected free with much difficulty and delay and replaced in canal, and the tissues containing the rudimentary laminae drawn together with chromic gut. Flaps from the lumbar muscles were resected and drawn over the cleft and sutured, with double row of gut. Skin with silk. Child apparently in fair condition but died in a short time after removal to the ward.

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The results obtained by the application of caustics to the sac (increase of paralysis) are identical with those following injection of the sac with irritants (Morton's fluid) if the protrusion contains nerve elements

CASE VI — *Spina Bifida Occulta with Paralysis of Legs* — B S, age four and one-half years, full-term child, normal delivery Paralysis of legs not complete, from birth, and urinary incontinence No rectal disturbance Right leg more paretic than left Examination showed at the lumbosacral juncture a diffuse lipomatous growth which extended over the left buttock (see Fig. 7) The prominence of the left buttock is due to the lipoma which extended over the cleft No hypertrichosis No defect could be felt in the spine, but the X-rays showed a defect in the fifth lumbar vertebra and the two upper segments of the sacrum, extending more to the left side (see Fig 8) Legs markedly paretic, with marked atrophy Knee-jerks absent No Babinski Sensation normal Incontinence of urine

Operation — S-shaped incision (Fig 7) over the defect as noted by the X-rays Mass of fat overlying the defect and found in the cleft Dura absent in the gap Many adhesions found among the roots of the cauda, but no protrusion through the cleft The adhesions found were removed and also the mass of tissue lying in the cleft Lumbar fascia drawn over the cleft and sutured by double row of chromic gut Skin with silk Dressed daily No infection Three months later there was no improvement in paralysis or incontinence Legs were somewhat larger and right knee-jerk was obtainable Her present condition is about the same In this case, contrary to that of Case I, we probably did not do enough, and a second operation is contemplated

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DEVELOPMENTAL RECONSTRUCTION OF THE COLON BASED ON SURGICAL PHYSIOLOGY*

By JEROME MORLEY LYNCH, M D

AND

JOHN WILLIAM DRAPER, M D

OF NEW YORK

EMBRYOLOGICAL development, extra-uterine growth, and physiological requirements fuse strikingly with other factors to elaborate lesion-characters and symptoms which are not alone typical and peculiar to the colon but essentially constant, easy of demonstration and of paramount vital value. Its origin, its growth and its work, then, must be of trenchant import to all who seek a knowledge of the great gut in disease.

In the earliest period of development, the vitelline duct or yoke sac, which later may result in Meckel's diverticulum, marks the dividing line between the fore- and the hind-gut (see Fig 1). About the third week of fetal life there appears in the posterior limb of the U-shaped tube a diverticulum which becomes the future cæcum and appendix. Thus it is clear that a portion of the small adult bowel is embryologically identical with the great gut, and this explains in a measure the apparent vicarious assumption of colon function by the terminal ileum, which will be referred to in the clinical part of this paper.

Of course it must be understood by all that it is necessary to have a thorough knowledge of the physiology as well as the embryology to make deductions. For, though the organs are allied embryologically, it does not follow that their functions are also closely associated. The proposition we have enunciated does not hold good with organs that are highly specialized, such as the kidney and heart. It applies only to organs that are less highly specialized and older in function, such as the caudad ileum and colon.

A proper understanding of the various arrests or malformations that may occur in the caudad end of the gut, often resulting in disease, may be obtained by a knowledge of its development.

About the end of the third month a rotation takes place, and the cæcum comes into position over the right kidney (see Figs 2 and 3).

* Studies from the Clinic of Gastro-Intestinal and Rectal Surgery of the New York Polyclinic Medical School and Hospital and from the Laboratory of Physiological Surgery of the New York University Medical School.

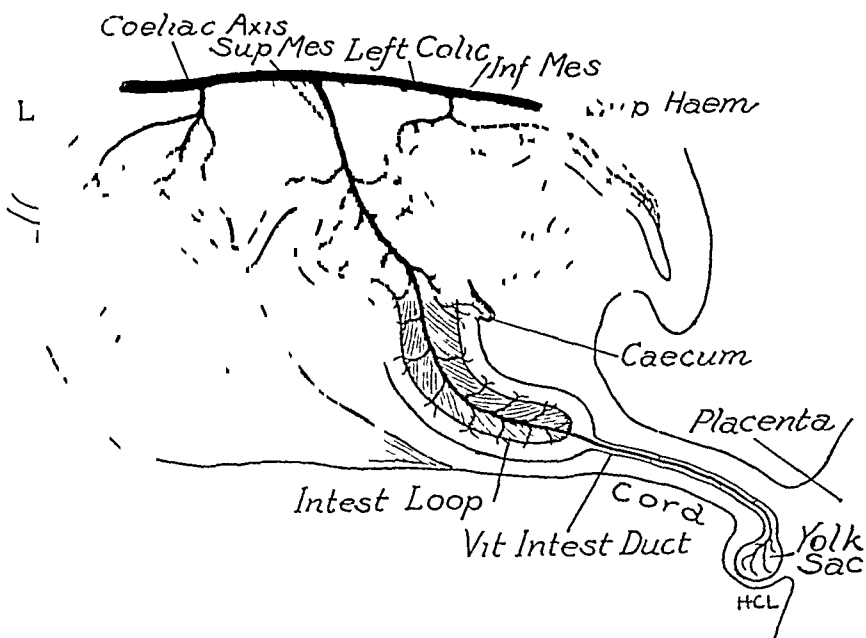


FIG 1 —This figure shows the bud which appears on the posterior limb of the V-shaped tube, aboral to the vitelline duct. It shows not only that the transverse ileum and the colon have a common embryological origin but that, at this period, the diameter of the small gut is greater than that of the large gut (Keith)

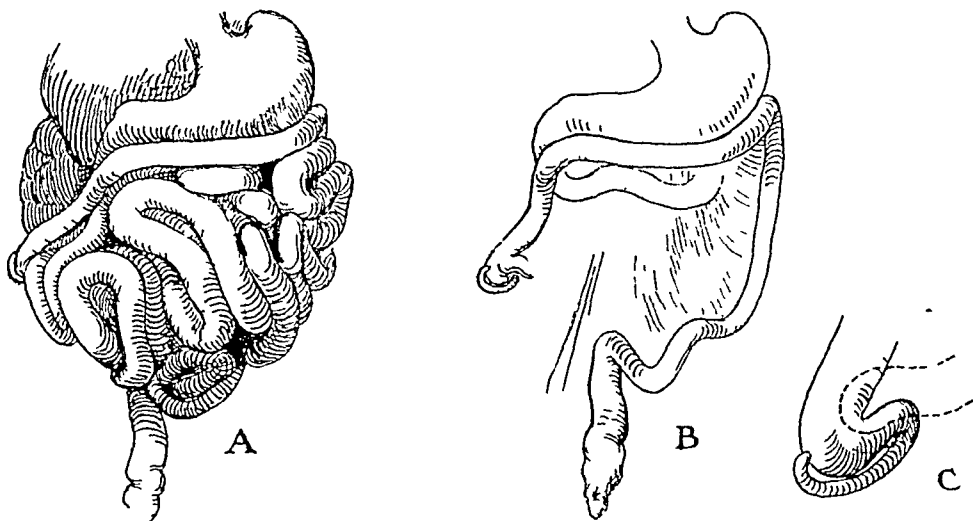


FIG 2 —These drawings were made from a human foetus at three months. They show that the caecum occupies a position identical with that in the adult human after the operation for developmental reconstruction of the colon, namely near the right kidney. Being drawn to scale they also show the relative size of the large and small guts at this stage of development (Lynch)

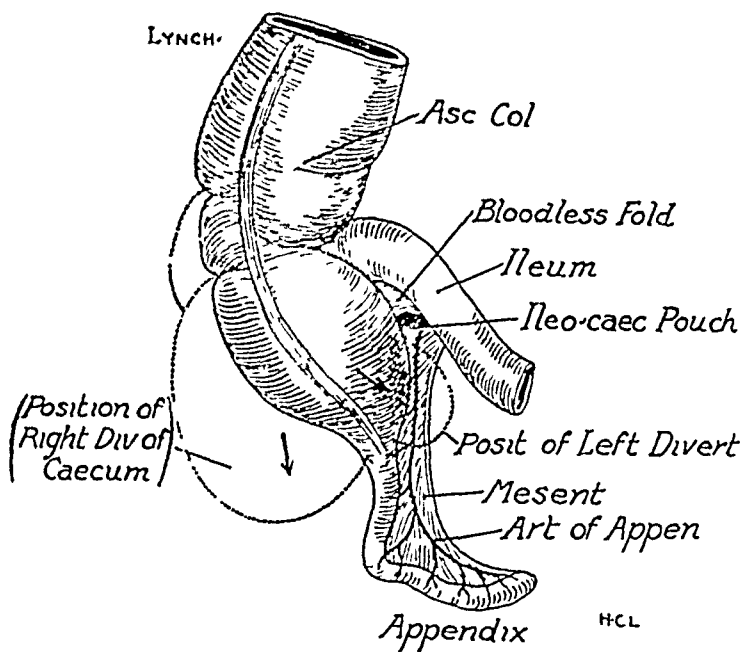


FIG 3 —Development of the cæcum showing three primary diverticula and the primitive, funnel shaped appendix (Keith)



FIG 4 —This figure shows the extent of colon removed, and the relations to the middle colic artery (Courtesy of D Appleton and Company)

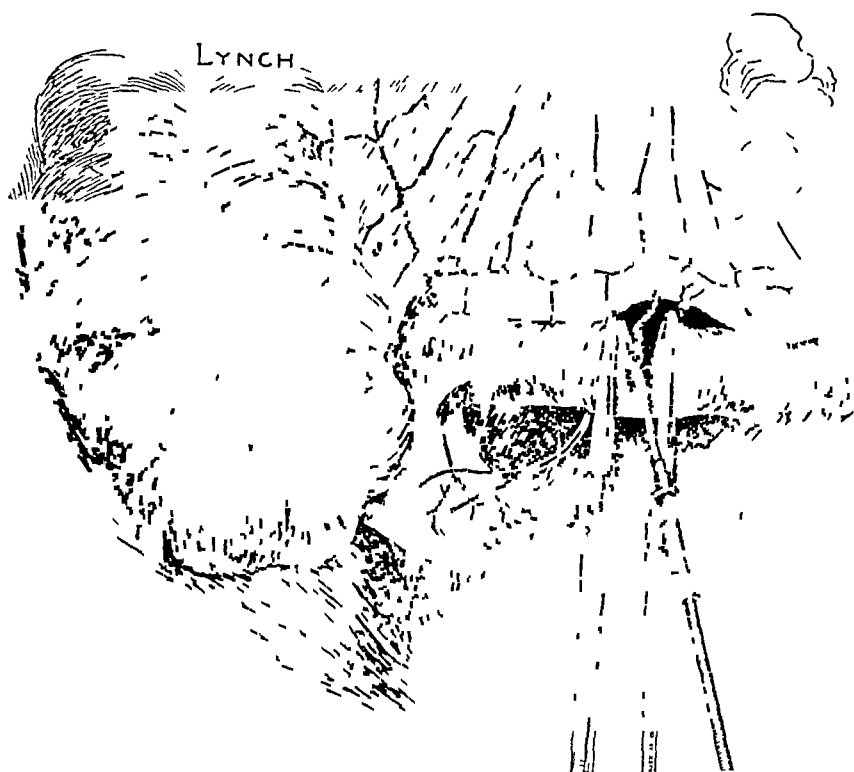


FIG 5 —Resection of the ileum by cautery. The same technic is used on the transverse colon (Lynch)

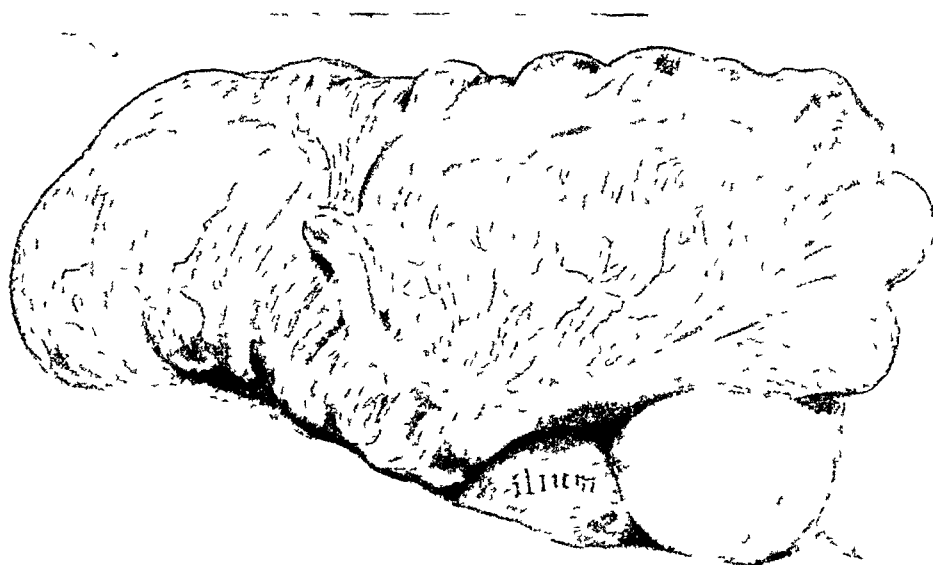


FIG 6 —Scale drawing of a latero-externally placed appendix which was removed from Case No 375. Note the funnel-shaped embryonic type of cæcum and also the relation of this cæcum and appendix to C of Fig 2. Appendectomy failed to relieve the symptoms. Developmental reconstruction six months later has effected a cure (Lynch)

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In this, which has been called the second position, it rests until birth, when under *normal impulses* it gradually migrates to the right iliac fossa. In the dog, the second position is the final one, and in the light of recent studies in intestinal stasis it may very reasonably be questioned whether man would not have been much better adapted to the upright position and consequently more efficient, had the evolutionary process left his colon in the canine position. Certain it is that the operation of partial colectomy, the technic and value of which have been demonstrated by Bloodgood, and which has given such striking relief in a certain type of toxic cases, is nothing more than a reconstruction of the colon to the second or developmental position. Developmental reconstruction has been done by the authors in fourteen cases which afford basis for the clinical deductions presented. The technic of the operation can easily be followed by consulting Figs 4 and 5.

Under *abnormal impulses* both the rotation and migration may be aberrant, with resulting malformations which are often accentuated by later growth. During the migration the appendix may be caught either posteriorly or laterally (see Fig 6). These malformations evidently often lead to functional derangements, with consequent infection, inflammation, ulceration, pericolicitis, or new growth. In direct sequence may here be cited the clinical history of the J family. Of seven children, four have been operated on for chronic appendicitis. Of the three remaining children, one has definite symptoms, one indefinite symptoms, one has no symptoms. A month ago the mother, aged sixty-four, who had been a chronic dyspeptic all her life, came to an emergency operation and a retroperitoneal purulent appendix was found. This is by no means an isolated instance of the occurrence of appendicular trouble in families, and Satterlee has called attention to the hereditary element in ptoses, of which appendicitis is so frequent a complication. This suggests the application to clinical study of the well-known law of heredity that, while acquired malformations are never inherited, the congenital forms are apt to be. In the type represented by the J family, therefore, an explanation based on hereditary misdirection in the cecal migration from the second to the third position is as reasonable as is the assumption of an hereditary factor in the narrowing of the costal angle, which is an outward manifestation of ptosis, and which has been found accompanying the ptosis cases cited by Satterlee. Rovsing has called attention to the frequency with which the hereditary element is encountered.

Professor Stockard has furnished us with a specimen of intestine, from a man forty years old. The total length from stomach to anus was ninety-six inches. Nature had so beautifully maintained the balance in

this case, that the circumference was found by measurement to be directly proportionate to the length

The *function* of the colon is dual *elimination* and *absorption*. Elimination is purposely placed first, for the reconsideration of the older physiological teaching has already come to be of great concern to surgery. Brown and Blake and Draper have shown that in dogs the doubly excluded and occluded colonic segment will fill to bursting within a few days, even if very carefully cleaned before occlusion. It is thus a pertinent question what to do with partially excluded colonic segments in human beings. Until recently this function seems to have been looked upon chiefly with academic interest. One usually and naturally associates the colon with its most evident function, that of fecal storage and discharge, overlooking its fundamentally important attributes. This attitude is not directed particularly toward the colon, but coincides with the general viewpoint regarding other matters of surgicophysiological importance as, for example, the "biliary" function of the liver and the so-called "digestive" activity of the stomach. In each the evident and supposedly important function has completely overshadowed the less evident. But the subtle cryptic functions are proving to be the very ones of greatest value to surgery and only through their interpretation can the crude applied art of to-day hope to become the finished science of to-morrow. And we are rapidly learning that only what is biologically true is of fundamental therapeutic worth. Intestinal obstruction is illustrative of this, the only therapeutic measure of any clinical value after a mechanical release of the contents from obstruction having been found through biological studies. This interesting and little understood condition is also illustrative of the importance of the eliminative function of the colon, it having been shown that, in dogs dying of obstruction, the colon was characteristically hemorrhagic, no other gross or microscopical lesion being demonstrable. This is true also of human beings. Diphtheria toxins, pilocarpine, and the metallic poisons are further examples. Indeed, an important corollary from these observations must be that colonic irrigation with or without specific biologic media may be a laudable method of treatment for the above-mentioned conditions as well as of obstruction. Indeed, the authors are inclined to believe that the well-known efficacy of continued colon irrigation is effective in large part because of the mechanical washing away of the toxins with which the water comes into direct contact. In many cases of developmental reconstruction of the colon, their patients have absorbed as much as twenty-five litres of tap water during the first post-operative week. In addition,

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many litres flowed in and out, thus doubtless effecting direct elimination of toxins. This has been dwelt on by Combe. Analogies between the stomach and the colon are familiar, and one may be gleaned by studying the comparative effects of washing out the highly toxic duodenal and gastric contents, which usually accumulate in the stomach after operations on the alimentary canal, and the colon irrigations referred to. In interpreting the efficacy of stomach washing, as after morphine poisoning, we are, after all, only travelling where biology points when we assume that colonic irrigation has much the same value as gastric lavage. Further analogies between the stomach and the colon will be alluded to later on.

The eliminative diarrhoeas of constipation, of the syndrome called goitre, of nephritis, of syphilis, after the giving of salvasan, further demonstrate that surgically the colon should be looked upon first as an excretory organ. But animal experiments show clearly that this applies only to the caudad colon. If this be true in the human, as seems reasonable from analogy and observation, then we certainly should hesitate to deprive any individual of so very important a function by the operation of total colectomy, and this irrespective of further metabolic considerations. Surgery, ceasing to be merely an adjunct to medicine, is rightly becoming the active collaborator of chemistry and physiology.

In studying the absorptive function of the colon, surgery has come further to the aid of physiology. Certain new facts of undoubted importance in human therapy have been learned by making use of surgical material, which recent operative procedures have afforded. Any digestive and absorptive function of the colon may naturally be taken on by its embryological prototype, the caudad ileum. Our surgical cases seem to prove this, and these human studies corroborate Cannon's animal findings as to the close physiological relationships between stomach and cæcum.

From a digestive stand-point the stomach and cæcum are unimportant. They are both receptacles, and if their motility is not impaired, they normally retain faint traces of digestive functions. The loss of these latter are not felt by any individual if the former is retained. Thus, every observer knows that the objective symptom called achylia gastrica may exist without any subjective symptom developing, provided that gastric motility remains normal. Von Noorden (*Path of Metabolism*, p. 186) says, "Protein putrefaction in the stomach reaches a high degree only in the most exceptional cases, and only when both the *secretory and motor functions are completely out of order*." Theoretically

cally, as just stated, any digestive and absorptive function of the colon should naturally be taken on by its embryological prototype, the caudad ileum. Clinical experience and animal experimentation prove to the authors the stability of this hypothesis, based, as it is, on embryology. Their studies after ileostomy support it.

It is well at this point briefly to review the absorptive and related functions of the colon, as given by physiologists, and then to consider the further details of our researches.

In a recent paper Hertz says, "Antiperistalsis does not occur in man under normal conditions; the ileocecal sphincter does not always prevent regurgitation into the ileum. . . . There can be no doubt that the function of the sphincter is, as Keith originally suggested, to prevent the contents of the ileum passing too rapidly into the cæcum."

This function is supplemented by the normal inhibition that is resident in the terminal ileum and can be accentuated under physiological requirements. The preservation, in part or in whole, of this inhibitory segment will, in the future, undoubtedly be an important factor in determining the point at which the ileum is to be cut, prior to ileocolostomy. This is supported by our clinical findings.

Drummond says, "After ileocolostomy the dilated coils of small gut adjacent to the colon assume somewhat the functions of the large gut."

Von Noorden states, "Numerous experiments introducing protein bodies (myosinogen, egg albumen, and casein) into the rectum have shown conclusively that an absorption of natural protein takes place in the rectum and colon."

Chittenden says, "In the large intestine the last portions of available nutriment are absorbed."

Howell states that when the contents of the small intestine pass the valve they contain a certain amount of unabsorbed food material. "The food," he says, "in this portion of the canal is more or less liquid, and its presence sets up running waves of constriction which, beginning somewhere in the colon, pass toward the ileocæcal valve. These waves occur in groups, separated by periods of rest. The pressure of the ileocæcal valve prevents the material from being forced back into the small intestine. The value of this peculiar reversal of the normal movements of the bowel at this particular point would seem to lie in the fact that it delays the passage of the material toward the rectum, and, by thoroughly mixing it, gives increased opportunities for the completion of the process of digestion and absorption." This

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colonic digestion, it is conceded, must take place through the action of the enzymes, which are brought down from the small bowel and which, under favorable conditions, continue their activity in the colon. In this way it is estimated that at least from one to seven per cent of the undigested foodstuffs, chiefly fats, are utilized. Now, if this is so, it means that a patient whose colon is static may lose this amount of food. Sir William Macewen was so impressed by this and by a case that came under his observation that he made the statement that, if the chyme was allowed to escape cephalad to the ileocæcal valve, the patient would lose weight, and that under those circumstances artificial feeding should supplement the ordinary diet. Our experience is at variance with this. Not alone is the loss of the normal absorptive function of the colon insignificant, but it is greatly overbalanced by the damage done to the organism through the toxic action of the end products of bacterial proteid dissociation which frequently occurs in the ill-developed, slowly emptying cæcum and ascending colon. One characteristic result of this toxæmia is mental depression, which may even go so far as to result in mania.

CASE No 1832 while at school attempted suicide three times, was treated by competent men from a neurological stand-point, and was finally operated on by Tuttle, with complete symptomatic relief.

CASE No 2061 had been imbecile and bed-ridden for a year but recovered after ileostomy. Her debility was so great that the operation had to be done under local anæsthesia.

CASE No 1180 (Path No 2081) presents the following data. Ileostomy, male, aged thirty, physician, weight 120 pounds, operated on April, 1912, for relief of acute inflammatory condition of colon with multiple polyposis. Owing to the existence of a common mesentery for ileum and cæcum, both were brought outside the wound. Both were opened on the ninth day. Soon thereafter the following observations were made. The reaction of the ileac contents was always acid. The flow of contents was not constant, often being interrupted for several hours. Its consistency varied with the diet, excessive nitrogen caused fluidity, on mixed diet content was fairly well formed, sometimes very hard, when large, stick-like movements would be passed. No putrefactive germs, either anaerobic or aerobic, were found. No fecal odor was ever noted. Occasionally the odor was pungent and distinctly unusual. The only enzymes ever present were amyl-opsin, a marked, steapsin, a faint trace. Gain in weight over twenty pounds.

Another function that physiologists attribute to the cæcum and ascending colon is the absorption of water, all the water normally shall have been absorbed when the contents reach the mid-transverse colon. Surgeons have made ample use of these observations in support of various technical procedures, and a careful study of post-operative conditions shows, in some cases at least, that their premises or conclusions, or both, were incorrect. Our studies in the surgical physiology of the parts strongly suggest that embryology and physiology should always precede pathology as a basis for surgical therapy. Indeed, Bloodgood, doubtless the best qualified surgical pathologist living, states that the future hope of surgery lies in physiological chemistry.

Obviously, one cannot properly reason from a secondary basis alone, such as is offered by pathology, without having constantly in view also the elemental or primary sciences of embryology, physiology, and chemistry. Without, therefore, a knowledge of the intimate co-relationships that exist between all parts of the body in general and certain parts in particular, applied, or, as it is frequently and erroneously called, "practical" surgery cannot be further developed. Structures of common embryological origin, like the cæcum and caudad ileum, may show the greatest possible morphological variation, and yet lend themselves favorably to applied reconstructive surgery when this is done in harmony with both their origin and their function. Thus, the predominant conception to-day that the caudad colon, that is, the part aboral to the mid-transverse line, is capable of vicariously assuming the functions of the cæcum and ascending colon, as after ileocolostomy, may be correct, but is, in our opinion, incomplete. Surgeons have been led astray by the gross morphological differences between the caudad ileum and the cæcum, forgetful of the facultative co-partnership that must just as truly exist between these embryological units as between the morphologically identical portions of the colon. This, at least, seems to us a reasonable basis for explaining the observed interchange of function between the ileum and the colon, which we have herewith recorded. It may also serve to explain the present difficulty in forecasting the end-results after such operations as ileocolostomy. After the implantation of the ileum into different parts of the colon, a persistent diarrhœa or constipation has been known to occur. As a general rule, the diarrhœa ceases after a short time, but the constipation has proven to be a much more difficult problem to deal with. The explanation of these two facts is now apparent: the vicarious assumption of colonic function by the ileum is almost sure to come, it absorbs water and forms the fæces, but the constipation, a pathological condition which existed in the ileum

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previous to operation, obviously could not be influenced by the mere change of ileac position brought about by this type of operation. It might be influenced, perhaps, as shown in author's case No 2012, by the exclusion of the inhibitory segment of the terminal ileum. Here the anastomosis, owing to adhesions, was made considerably oral to the termination of the foregut and, consequently, oral to the inhibitory segment. Indeed, this operation must increase the normal inhibition belonging to the part, thus aggravating the symptom. This increase of constipation has been noted in practice. This is quite distinct from the constipation due to anastalsis, and which frequently packs the cæcum after ileocolostomy, until its entire removal is necessitated. Lane states that this may be necessary, and Patterson places the instance at 5 per cent or over. Probably it is much higher. Careful clinical study along these physiological lines is obviously indicated, so that surgeons may re-adjust their technical procedures upon a sounder basis. The ileac constipation is as yet open only to medical therapy and for this reason every effort at differential diagnosis between the two should be made.

Hertz presents some facts of interest here. He says, "An accumulation of chyme occurs in the last few inches of the ileum, where it remains and undergoes digestion, actually for a greater period than in the stomach. The normal ileac stasis is increased in all conditions leading to spasm or to the inhibition of the normal relaxation of the ileocæcal sphincter."

Conclusions based on the X-ray alone may lead one into grave error, owing, first, to the fact that roentgenologists are still unable to differentiate between stases due to mechanical and reflex causes, as, for example, between a mechanical kink and an ileac constipation, and, second, to the fact that it has not yet been definitely settled whether bismuth traverses the gut at the same rate as ordinary food, or slower.

What are our further proofs that cæcal digestion is negligible?

At a certain period of fetal life, as already said, there is little difference between the morphological appearance of the small and great gut. The latter, at first much smaller than the former, contains villi which are later obliterated, the process of obliteration not yet being definitely settled. It is assumed that Lieberkuhn's follicles are inverted villi. If so, they may, under the pressure of physiological requirement, revert to the fetal condition and vicariously functionate as villi in fat absorption. But fats must be emulsified before they are fit for absorption, and under the catabolic influence of lipase, which is present

in the colon as in all other tissues, emulsified fats may here be digested. In support of this, Tuttle claims to have increased the weight of a patient by the injection into the cæcum through a cæcostomy of emulsified fats. For the purpose of surgical physiology, however, it appears that the amount of fat absorption in the cæcum and ascending colon is of academic interest only.

Carbohydrate and proteid absorption in these parts occurred in Case 180, Path N 2081, as follows: Grammes, 30 dry peptonoids were mixed with grammes 113.4 warm water and introduced into the rectum at 11 P.M. At 8.30 the next A.M. the bowel was washed out from above with sterile water and the residue examined. Analysis of the peptonoids introduced was as follows (Lab. of Physiology, Cornell University): Protein 39.81, carbohydrates 50.05, water 4.72, ash 5.32.

Analysis of washings showed that one-half the sugar and nitrogen had disappeared. There was considerable fermentation which probably had a good deal to do with the disappearance of the sugar.

The nitrogen was in the form of amino-acids. This experiment suggests that proteins in the form of amino-acids may be absorbed from the colon. Normally, however, the amino-acids are absorbed in the small gut only. Under abnormal conditions of incomplete hydrolysis, peptones and other provisional products of protein digestion probably enter the cæcum, there to be converted by the proteolytic bacteria into the highly toxic by-products which, directly or indirectly, cause the familiar symptoms of stasis. Combe has called attention to the necessity of removing them by enemata. Adam regards the condition as a subinfection. Abderhalden has proved that the final product of physiological protein digestion is the amino-acids, having recovered them from the blood. It is clear, therefore, that for the purposes of modern surgery protein digestion in the colon is as unimportant as it is in the stomach.

Rectal alimentation has long been a comforting and satisfying therapeutic procedure in the hands of the profession. It was ancient medical history when Hippocrates was a boy. Recent physiological studies, however, show that the hypnotic influence of this old method of vicarious feeding has been at least as great upon the physician as upon the patient and his awe-struck family. Probably, the good which it is conceded may follow it has been due to the therapeutic action of the water and in no way to the food.

Our medical heritage is almost as rich in bewildering stimuli as our atavistic, which long antedates the batrachians. The one moulds our therapeutic ideas, the other fashions our form. We are encum-

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bered with a faith based upon a horde of inherited misconceptions, and the subject of rectal alimentation is only one of the many instances which prove it. Far be it from the province of surgery to set these right, surgeons are not Hamlets, but it is fair to say that the recent rapid progress of colonic therapy has contributed more than any other single factor of the day to endorse reconstructive ideas as well as applied procedures, and to show the pressing need of cooperation between the laboratories of the fundamental sciences and the hospital operating rooms. The unfriendly attitude existing in the past between physician and surgeon was a misunderstanding arising, as always, from ignorance and is rapidly being put aside. Medicine has evidently been at fault in treating, as in dyspepsia, the peripheral manifestations of some remote insult to the sympathetic system. Surgery, equally undeveloped, was at first simply the emergency tool of medicine, necessarily poor and crude. Gradually light has come from physiology, embryology and chemistry, until to-day surgery is able to offer, in selected cases, a therapy which, in removing the cause of disease, often effects a true cure. Such therapy is based on the incontrovertible premise that human beings are normally healthy animals and that for many chronic diseases there is a mechanical cause.

Intestinal stasis with its long train of protean and distressing symptoms is evidently a common ground upon which physician and surgeon may profitably meet to discuss, without bias or prejudice, the therapy of the future. Whether the developmental reconstruction of the colon herewith described will prove to be of lasting value may, perhaps, be doubted, but one argument favoring its continuance may well be its basis on embryological truths. It aims to correct a congenital deformity and is thus a form of orthopædic surgery. This speaks for its continuance, for the repair of congenital deformities must obviously continue long after the surgery of tumors and inflammations has happily passed away.

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COLOCOLOSTOMY

A PRELIMINARY REPORT ON AN OPERATION FOR THE CONSERVATIVE RELIEF OF THE
SYMPTOMS OF COLOPTOSIS AND COLOSTASIS

BY ANDREW STEWART LOBINGIER, M D
OF LOS ANGELES, CAL

WE are seeing an increasing number of patients suffering from a more or less general visceroptosis, on whom appendectomy, gastroenterostomy and gastropexy have been done and in whom the nutritional index continues far below par. The position and pathology of the colon in these patients have either been overlooked or only partially corrected.

This neglect has obviously not been intentional, it has been the outgrowth of the compelling notice which the pathology of the stomach and the duodenum has commanded. In some instances it has arisen from the disinclination to do too much visceral surgery at one sitting or to insist that the necessary work be done in two stages.

These patients are more frequently women than men, and are often classed as neurasthenics. The symptom complex is familiar to us all. They have pendulous abdomens, drooping shoulders, cold and clammy feet and hands, yellow complexions, coated tongues, and are constipated. The appetite is variable and capricious, there is marked indicanuria, they have frequent headaches, are mentally depressed and at times melancholic.

Many of them suffer from gas pains due to over-distention of the ascending and transverse colon. The descending colon is relatively collapsed and tonically constricted at its junction with the sigmoid, and, as has been repeatedly observed, this spasticity will persist even through a prolonged etherization.

A gastropexy with or without a plication of the gastrocolic ligament will not correct the essential defect in the position of the colon which produces these distressing symptoms. This defect is due to the very acute angulation at the splenic flexure, and not infrequently at the hepatic flexure, preventing the onward movement of gas and feces and resulting in stasis of the colon contents.

The various methods of suspending a prolapsed and redundant colon have mostly proved inefficient, and absolutely so for the sharp splenic angulation.

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Cutting the colon out of the alimentary *via* by an ileosigmoidostomy or by a cæcosigmoidostomy has often been followed by failure to relieve the symptoms. Not infrequently the patient has been left in a plight more distressing than that for which he sought relief.

Total extirpation of the colon is a formidable procedure for the most experienced surgeon, and it must remain a serious question whether its justification can be consistently defended for that type of colonic stasis due to functional atony, ptosis and acute angulation.

With a view to suggest a conservative measure which should maintain the alimentary purpose of the colon and immediately relieve the

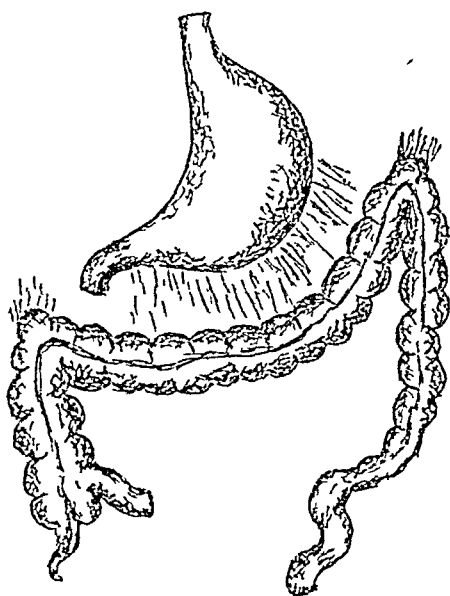


FIG 1—Showing the splenic and hepatic flexures in their approximately normal angulation

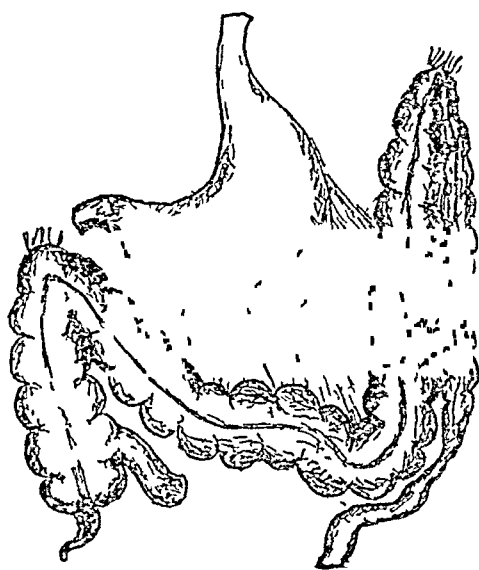


FIG 2—Showing dilated ascending and transverse colon and sharp angulation at the splenic flexure. The descending colon is one-third the diameter of the transverse and is in spastic contraction at its junction with the sigmoid

stasis and attending symptoms, at a meeting of the Los Angeles Clinical and Pathological Society two years ago I proposed the operation of colocolostomy.

At the last meeting, in May a year ago, a more detailed verbal report was presented with clinical observations upon five patients in whom the indications for the procedure seemed well established. Since that report four other patients have been operated upon.

It is obviously too soon to offer an opinion as to the permanency of the benefits to be derived from the anastomosis. But no unfavorable incident has thus far attended the operation and the patients have been so greatly improved as to lead me to venture to offer this preliminary

report with a brief technical description, in the hope that the procedure may prove one of value

In all the cases the radiograms, which with one exception were taken with the patient in the standing position, showed the colon within the pelvis. In most of them the greater curvature of the stomach was several centimetres below the umbilicus. In one patient the stomach was down upon the pelvic brim.

The gastrioptosis was corrected, in those requiring it, as a preliminary step. The technic of Rovsing was the one usually chosen. Plication of the gastrocolic ligament was found necessary in most of the cases.

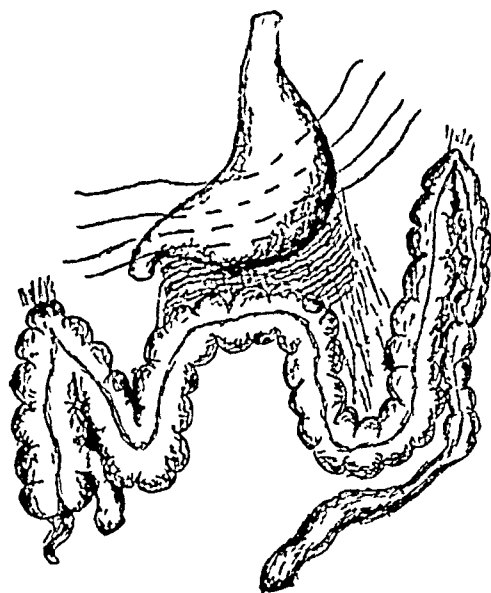


FIG 3—Suspension of the stomach and plication of the gastrocolic ligament only elevates the central segment of the transverse colon, the angle at the splenic flexure is not in the least changed or improved

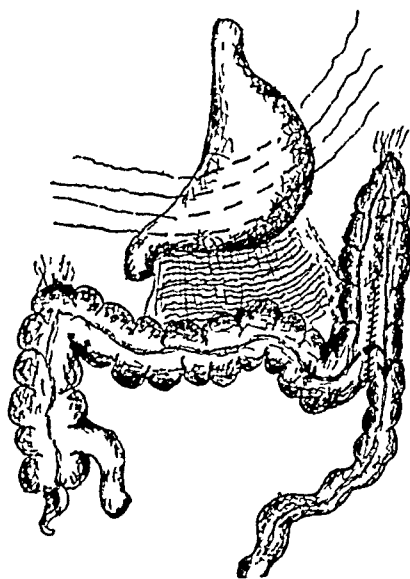


FIG 4—Suspension of the stomach, plication of the gastrocolic ligament and a colocolostomy between the ascending segment of the transverse and the descending colon, reestablishes the colon current and relieves stasis

In those cases showing the hepatic flexure at an angle of approximately 90° , the anastomosis was done only on the splenic side, that is, between the ascending loop of the transverse and the descending colon.

Where, as is frequently seen in long and contracted waisted women, the angle of the hepatic flexure is 5° to 15° , the anastomosis will require to be done on the hepatic side also.

The site of the anastomosis is topographically opposite the umbilicus on the right and about two centimetres below the plane of the umbilicus on the left, through an incision through the rectus muscle.

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We found the transverse colon generally something more than three times the diameter of the descending colon. In three-fourths of the cases there was a marked narrowing of the descending colon for a distance of from three to five centimetres at its junction with the sigmoid.

The length of the anastomosis should be five centimetres.

The customary clamps and sutures used in gastro-enterostomy were employed.

The colon had been previously carefully flushed out with salt solution.

The strictest precautions in toilet required in the surgery of the colon were observed. In order to avoid the possibility of a loop of ileum slipping forward between the segments of the colon above the anastomosis, a line of sutures in the serosa should extend along the anterior bands from the upper angle of the anastomosis to the splenic flexure.

DUODENOTOMY IN COMMON DUCT STONE

BY GEORGE M. TODD, M.D.

OF TOLEDO, OHIO

SURGEON TO ST. VINCENT'S HOSPITAL

FEW surgeons seem to realize that there is no typical operation of duodenotomy and that the word itself barely exists, although corresponding intervention into most of the cavities and organs is thoroughly recognized. The idea of a primary duodenotomy for duodenal ulcer is, of course, recognized for ulcers of a certain kind or site, for example, those on the posterior surface and hemorrhagic ulcers, but those may be left out of consideration here. According to those who have endeavored to trace the history of duodenotomy, the exploratory operation was first to be performed (Abbe, 1891), but, as will be seen, duodenotomy for stone began the same year. Some authors have sought to compile a list of duodenotomies for exploration, but few of these were single in character, for the exploration almost invariably led to the discovery of a calculus or cancerous growth. The duodenum has also been opened for exploration and operation on the pancreas. Since the overwhelming large numbers of duodenotomies have been for stone, the propriety of using so many compound expressions which signify the removal of stones through the duodenum is of highly questionable value, and has caused no end of confusion, nor does it seem much wiser to specify the precise site and direction of the incision as a sufficient reason for recognizing more than one kind of operation.

A word as to the existence of duodenotomy for stone before 1891. Langenbuch, as is well known, suggested the operation in 1884. Elsewhere he speaks as if he had actually done an operation like Kocher's, in the same year. He must, however, be referring to choledochotomy in the original sense, to wit, the establishment of a fistula between the choledochus and abdominal wall. A number of such operations were performed in the eighties, and there is no record that the duodenum was opened in this form of intervention.

Speaking of duodenotomies for stone, these have usually been grouped into three kinds, in the first, the operation cannot be called a choledochotomy. After the duodenal opening, the stone may be simply extracted or forced outward, or even crushed. The choledochus is not

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incised at any time. Why, then, call it a choledochotomy? It is a simple duodenotomy for extraction of stone which is almost loose, indeed, at times, actually loose. Next comes the numerically most prominent form in which the stone is impacted in the ampulla but readily freed by a small incision, too small as a rule to require suture. The third operation in which the stone is very large requires a sufficiently large incision for suture. To which is often added a plastic work, the formation of an anastomosis between the divided choledochus and the duodenum. It seems, however, that some surgeons prefer to employ this operation for routine purposes and, in general, the confusion between the three operations is great.

Thus in Kehr's latest work (*Der Praxis der Gallenwege-Chirurgie*, 1913) the author states that in 2000 operations on the gall-bladder and biliary passages, he operated through the duodenum, 29 times. He does not state particulars, but we know that at first he employs choledochostomy, or the third type of duodenotomy for stone. Many other writers have used the terms indefinitely, saying one word when they mean another. Attempts have been made to compile two sets of statistics, one including the first and second type and the other the third, and keep them strictly separate. On account of the meagreness of many case reports, this is impossible, nor can we go by titles, for a choledochostomy as already cited may be a simple choledochotomy, the opposite error is less likely to occur. Some surgeons lay more stress on the site of incision, *i e*, the height at which it is made, than in the treatment of the duct which depends on a variety of conditions.

In the following pages we shall make no attempt to discriminate between the three types of operation. There is another matter of great importance in which it is not essential to make vital distinction. This is as follows. Patients who submit to these operations differ in no wise from other patients with severe biliary lithiasis. The personal course and symptoms vary little from case to case, whenever we have complete obstruction of the choledochus. The various clinical pictures should be familiar to all practitioners. Nothing appears to be saved by attempting to divide them into groups.

The material for duodenotomy for stone or conditions simulating stone is not large. It was recently estimated at about 100, but by including other material, like duodenotomy for the pancreas, certain choledochotomies formerly excluded, and late reports, as well as old unreported cases, the number ought to be well on toward 150. In this paper we cite 130 cases at least. However, we almost invariably find

that the most extensive operators seldom choose the duodenal route, and then often on an emergency indication. In Kehr's 2000 we find but 29. The Mayos report 6. Mayo-Robson 21 (up to 1908). Moynihan 10 (up to 1906). The reason for this small amount of material seems to be that these surgeons use the duodenal route only on the strictest indications. Preferring cystotomy or the retroduodenal method (the latter is sometimes carelessly spoken of as a duodenal method). Mayo-Robson's cases especially show that he used the duodenal method in highly complicated cases, and then only to meet some otherwise complicated conditions.

Of interest is the fact that several authors believed that they were the earliest to practise duodenotomy for stone. This is due to the insufficient attention given to the literature. McBurney chanced to record his first case in 1891, but it was not until 1894 that other reports came in, while it was not until 1898 that McBurney reported his total of six cases. He did not even publish five cases operated on after 1898.

In 1894 several reports came in, those of Pozzi,² Terrier,³ Kocher,⁴ Kehr,⁵ At the same time, Kocher and Kehr independently introduced choledochostomy and Terrier's case falls under the same head. Pozzi's case fell under neither head and some would make of it a special operation, but his work was simply the result of conditions to be met, while endeavoring to reach the choledochus, he tore into the duodenum. It was found that a very large stone lay in the latter and common duct, having ulcerated through the latter. After having extracted the stone, the opening was carefully sutured. The patient's viscera were in bad condition, he having cirrhosis of the liver and extensive adhesions. Pozzi's operation was entirely unpremeditated. Therefore, in this group of 1894, not one was of the McBurney type.

In 1897 Czerny⁷ and his assistant, Marwedel, operated twice on a gall-stone patient. The first, a cystotomy, found the choledochus apparently clear. Obstructive symptoms supervened eighteen months later, adhesions found between the gall-bladder and duodenum were accidentally ruptured into the latter, permitting removal of a stone low down in the choledochus. Hence this case is in the same class as Pozzi's first. Mayo-Robson's first operation, in 1897, we believed by Kocher's method.

In 1898 there was general activity in this field. McBurney reported his six cases. Langenbuch reported a case of duodenotomy for stone, with suture. Mayo-Robson reported his second case, having operated by McBurney's method. Collins,¹⁴ of the U. S., reported five of McBurney's cases this year, but added nothing, and Carle,¹⁵ several cases before the International Medical Congress at Rome, of the same operation. A case cited by Langenbuch, known as the Sarrenburg-Hermes case, is said to have been unfinished, or an operative failure. Riedel⁹ reported a suture case. Haasler¹² reported a case of McBurney's as did Sinclair White.¹³ A case is attributed to Hoffman¹¹ during this period by

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Langenbuch A statement attributed to Kocher that in 1899 20 operations had been performed with two deaths, falls short of the facts The number should be much nearer 30 than 20 If, however, he refers to McBurney's operation, the number is approximately correct, as there were seven or eight cases of suture operations without counting others

In 1899 and 1900 several more cases were reported One by Pozzi² of McBurney's operation, a second by Lambotte,³⁰ a third by F Page¹⁷ An era of importance is now introduced of the gall-bladder and bile duct (1900) The author seems to have been very little acquainted with the history of the operation, but announces that during 1898-1899 he had operated in all seven times by McBurney's method As he had already published a case of Kocher's operation (1897), and his first McBurney case (1890), it appears that he added at least six new cases to the material It is readily apparent that by 1900 no less than 35 duodenotomies had been performed for stone

In 1901 Pataloni, of Marseilles, made the first serious attempt to write a monograph on "Biliary Intervention of the Duodenal Route" (*Rev de gynecol*, 1901, p 72) He rendered good services in outlining the history and solution of the operation but did not succeed in collecting all the reported material

In 1902 Robson²⁰ reported two cases of McBurney's operation (some writers credit him with three operations) Theinhaus²¹ gives a personal case, and adds some five others from personal mention W J Mayo²² reports a case Theinhaus did a suture operation The total should now be over fifty

In 1903 Gibson²³ reported a case of McBurney's operation The next year was a prolific year for our subject Mayo-Robson²⁰ published a second edition of his monograph He adds seven new cases, also reports one by Dalzell for duodenotomy for pancreatic calculus Ohl attempts to collect the total cases of duodenotomy for stone and knew so little of the literature that he could mention only a third of the published material He gives four cases of Sprengel's, chiefly of the Kocher type Then at the end of 1904, nearly seventy duodenotomies for stone had been performed

In 1906 we see another prolific year Hancock,²⁰ after reporting a case of McBurney's operation, stated that there were five cases of duodenotomy for pancreatic stone now on record (including Dalzell's, reported by Robson) Moynihan²⁸ published a comprehensive paper in which he speaks of seven cases of McBurney's operation and three of the suture or Kocher operation Lagurette²⁰ reports a single case of McBurney's type The total at the end of 1906 amounted to about 80 cases Kocher⁴ writes up 100 cases of operations on bile passages, aside from the original case, he has operated twice more, but a single paper appeared in 1907 by Webster,³⁰ of Chicago, who reports a case To the series of 1906 must also be added the five unpublished cases of Mayo and the five unpublished McBurney cases These McBurney cases bring the total up to over 90

In 1908 there was renewed activity Connell³¹ reported a personal case and cited unpublished cases from Sifton,³¹ Tinker and Sherk Mayo-Robson announces to correspondents that he had done 6 more operations since 1904, this gives an additional 12 cases which makes a total of over 100

In 1909 MacLean,³² of Winnipeg, reported a case, and in 1910 another report

appeared from Smythe,²¹ of Memphis In 1911 Bosse and Brotzen²² reported a single case

During 1912-1913 not a few cases have seen the light—Fobes,²³ W Meyer,²⁴ Williams²⁵ (Louisiana), Brewer,²⁶ Hubbard²⁷, this equals 6 cases Kehr's latest work, already mentioned, gives his complete figures as 29, of which 4 only seem to have been reported Deducting this number, we have 31 cases to add to the number of cases An unlocated case of Hoffman would make the grand total nearly 140 To do anything in the way of tabulation and analysis of these cases is straightway impracticable Some are given in full detail, but many are defectively reported, and not a few mere hearsay cases To select arbitrarily, certain cases for analysis of 94 cases collected by Connell²⁸ as sample for the purpose, but it teaches us little Of much more value should be the different conditions under which the operation has been done

In Hubbard's analysis of 94 cases he could only credit Kehr with 3 cases of McBurney's operation, while 8 of Kehr's own operations are not included He admits that some surgeons look upon the two procedures as identical His series of 94 he evidently regarded as all non-suture operations, but if he had read them all he would have found that not a few supposed McBurney cases were really suture cases In the 94 cases Hubbard could find records of but 12 fatalities Duodenal fistula was a theoretical objection, but two cases only seemed to have been recorded With modern technic fatalities and untoward sequelæ seem hardly possible

In regard to the operation itself, it must first be borne in mind that few of these are undertaken with the sole aim of removing a stone which blocks the common duct It is only as a sequela to a gall-stone operation, when the symptoms do not improve, or when the attacks by obstruction continue to occur, that we see operations directed solely to the ampulla, for the gall-bladder and cystic duct may have been sacrificed In the majority of cases, operation for gall-stones must include a thorough exposure of the other structures just mentioned These may be normal, or may demand immediate relief

In approaching the case histories we may cite a few of the latest accessors, which will throw some light on the causes for intervention, the selection of cases None of the cases were desperate and none of the reporters had operated before One operator had never as much as heard of duodenotomy, but improvised it Thus J C Hubbard,²⁹ of Boston, reports a very recent case A woman of thirty-eight was seized with the symptoms of biliary obstruction An incision exposed the biliary organs, but no stone was found, save a small one at the duodenal end of the common duct Since it could not be pushed out the duodenum was opened in front and the posterior surface incised over the stone Afterward the incision in the anterior wall was sutured, and the gall-bladder drained with a wick

Hancock's³⁰ case was also simple The patient had already had the gall-bladder drained along with 70 stones However, the symptoms of obstruction returned, and an impacted stone, overlooked, was found in the common duct,

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where it passes through the duodenal wall. The stone was firmly impacted. The anterior wall of the duodenum was incised, the papilla dilated and the stone removed. Later, the gall-bladder was removed.

In the case of Bosse and Brotzen,³⁴ the condition was evidently of long standing, and was thought to be confined to the bladder, which was bound with adhesions. The choledochus was pronounced patent. Gall-bladder removed. Later, further obstruction. Second laparotomy, found much scar tissue, choledochus could not be recognized in the mass. A small stone felt in the duct. Retroduodenal method found impracticable. Duodenum mobilized and incised in front. The stone was extracted. There was no drainage, but a tampon was used for a short time.

In the two preceding cases the choledochus was accused only after the belief that the trouble was in the gall-bladder.

In Smythe's³⁵ case the diagnosis had been gall-stones and stones in the common duct. In the operation an attempt was made to remove all stones through the cholecystotomy wound. Author had never heard of duodenotomy, but it seemed indicated. He found the duct thin and containing one large and several small stones. No attempts were made to suture.

The above four cases were all of recent date of a common type, yet presenting dissimilarities.

If we glance over these reports we note that the surgeons had never operated before and that this method appealed to them because it suited the indications, was not difficult of execution, was practically without mortality, and serious complications were absent. From the time of McBurney's, many of these cases had been performed. It is, however, almost certain that the heavy operators would have used a different technic, *i e.*, the general technic for all gall-stone operations, or the retroduodenal method. The single case operators mentioned above are not known to have used this resource again, probably from lack of opportunity. As a matter of fact, most cases have been reported singly.

There is a much more difficult type of case in which the operation has been done to save life. Here attacks of biliary obstruction have occurred during many years, operative intervention may already have been practised once or twice, the patient has become cachectic and severe complications may have to be dealt with. The biliary passage may have become the seat of inflammation (cholangitis), so that fever may be associated with the picture of obstruction.

Of this type was Kehr's first case. There had been biliary crisis for five years, which at last appeared almost weekly. The general state was most wretched. The icterus was intense and hypertrophy of the liver existed as complication. The gall-bladder was small and empty, adherent to duodenum and stomach. A large immovable stone could be felt in the duodenum. It lay directly opposite the anterior portion of the latter. Kehr, already a seasoned operator for gall-stones, saw no other way of reaching the stone but

by a transverse incision and then making a second incision directly upon the choledochus. The stone was removed, and the split duct sutured to the mucosa above it. Hence, for Kehr, this was really an emergency procedure. If we study the cases of the large operators we get the same impression. A majority of Mayo-Robson's cases were of this sort, many of them desperate. In the midst of a severe operation for small stones, he finds it necessary to do a choledochotomy before the work can be completed. He thus lost two of his early cases, one from infection and the other from acute gastric dilation. To take some of his subsequent cases without mortality,—in his case 354 the patient also had chronic pancreatitis and was suffering from an independent wound in the leg. The stone was large. The operation was successful (no suture of duct) and recovery rapid.

In another case, 436, the woman had had a long history of gall-stones, and had gone through a cholecystotomy, as a result of which she now has a biliary fistula. A duodenotomy was performed and the stone removed. As the duct seemed contracted, it was well stretched with forceps and the papilla laid open, all to prevent recurrence. There is evidence that recurrence will occur.

Case 480 was of special interest, because during manipulation after a cholecystectomy one stone was forced into the ampulla. As it could not be dislodged, the author was forced to perform a duodenotomy.

Case 487. There were both cholelithiasis and pancreatic calculi. There were performed cholecystotomy, duodenotomy and pancreatotomy.

Moynihan,²³ a frequent operator, reports some severe cases. In one woman he removed 87 stones from the gall-bladder, hepatic and common duct. He cut down the length of the common duct, but at the very duodenal end of the latter found a tightly impacted stone, for which he performed a duodenotomy. The choledochus was sutured from the gall-bladder downward. This patient died on the third day from hæmatemesis.

In another of his cases of a severe type, with gall-bladder useless, the latter was extirpated along with the cystic duct. Stone in ampulla removed by duodenotomy. Recovery ensued. In a third patient cholecystotomy was done after duodenotomy for drainage purposes. In a fourth, the gall-bladder was first removed, and later a duodenotomy for stone in the common duct performed. The gall-bladder stump permitted drainage by the cystic duct. It is taken for granted that gall-bladder or cystic drainage implies actual or possible infection.

Sprengel²⁴ had operated four times at an early date and his cases seem to have been unusually severe. The patient had already been operated upon twice (choledocystotomy). A third severe attack occurred and was found due to a stone in the ampulla. Duodenotomy and removal of stone. Gall-bladder drainage. Recovery. In another, case history of severe biliary obstruction. Operation located stone in ampulla. Choledochus opened above and attempts made to extract or push out the stone. This failing, duodenotomy was performed. Tampon near duodenum with hepatic drainage. Wound healing kindly when duodenal suture gave way. Tampon soaked with bile and blood. Emergency gastro-enterostomy, death. Autopsy wound in duodenum had undergone digestion. In a third case, the gall-bladder was full of stones, choledochus much dilated, with one stone in ampulla. High incision of choledochus.

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practised, but stone could not be dislodged. Duodenotomy and extraction. Hepaticus drainage recovery. In a fourth case, the gall-bladder was found adherent to stomach and transverse colon. Stones, few in number, removed through gall-bladder and duodenum. Recovery.

Kocher,⁴ who is reckoned as a prolific operator on gall-stones, had done up to 1906 but three duodenotomies. His earliest one was done by the so-called Kocher operation, which he originated almost simultaneously with Kehr (suture of incised common duct to edges of divided posterior duodenal wall). In his second case he found the duodenum fused with the gall-bladder. He partially loosened the adhesions. A stone lay in the choledochus, which at this point was surrounded by adhesions which could not be loosened. It could only be reached through the duodenum. The latter was opened and the pylorus temporarily closed. The stone was cut out and suture of the choledochus to the duodenum. Entire wound tamponed with external drainage. Convalesced slowly. A third case had tumor symptoms. Gall-bladder shrunken and adherent, no tumor. A body, thought to be stone, in choledochus. Duodenotomy with probing of common duct. Four centimetres from duodenum a stone found, character doubtful. Severe hemorrhage from tear in old adhesion led to clamping for two days. Wound meanwhile being tamponed and drained. Obstruction removed but no mention of nature. Death due to the adhesion afterward torn.

H. B. Robinson²¹ is said to have reported in all three cases. We have found two only. In the first, the author found the gall-bladder the seat of adhesions. In attempting to remove some of them, the gall-bladder ruptured, and was found to contain no stone. A temporary fistula was left and finally closed. There was another obstructive attack with reopening of the fistula. A second operation was performed. Diagnosis meanwhile of movable stone in the choledochus (intermittent jaundice). Numerous dense adhesions had to be disposed of before the latter could be reached. No stone could be found, and the wound was allowed to heal. The obstructive symptoms reappeared and a third operation performed. Gall-bladder and duct in good condition, no stones, but a slight thickening at the lower end of the choledochus. The duodenum was now opened, and incision of the duct showed a concretion the size of a marble.

The other case was evidently infected cholelithiasis. Laparotomy—all the biliary organs in position to be examined. Gall-bladder empty. Two stones in choledochus removed through duodenum. Recovery.

Brewer²⁸ has operated at least twice with fatal results. In Brewer's first case he blames only himself. Patient, an old man, with gall-stone disease and fever, underwent laparotomy. Common duct much dilated, containing what seemed to be an enormous stone. The gall-bladder itself infected and was extirpated, the duodenal end of the choledochus clamped and the contents of all the ducts removed. The duodenum was now entered, the common duct enlarged and the mass removed. It was not a stone but inspissated bile and pus, the result of an old fistula between the gall-bladder and duodenum. The supposed common duct had really become effaced. The new passage had become infected. The operation was a very long one and was successful, but death took place the sixth day, from hypostatic pneumonia.

Brewer cites briefly a second case in an old woman. He first did a duodenotomy, dilated the lumen of the duct with Kocher's forceps, but found no

stone He then made an anastomosis between the gall-bladder and duodenum Death resulted.

A fatal case mentioned by Lilienthal in 1903 may perhaps have been a direct duodenal fistula It occurred in the practice of a colleague and is termed a duodenotomy The author mentioned it in discussing a paper by Gibson, on what was evidently a McBurney or Kocher operation The death took place from a leak in the duodenal wall, with resulting peritonitis This accident is not feared in duodenal operations

Pozzi,² in addition to his accidental duodenotomy, performed a second operation of the familiar type

Clarke,³ a French surgeon, simply announced that he had operated by duodenotomy several times with success He thought the operation original with him, or at least states that he knew nothing of the cases of Kocher and Pozzi However, he mentions Terrier, as if he had employed the latter's technic It is hearsay that Ferguson and Oschner, of Chicago, have each operated twice The four cases are not on record Sifton is also said to have operated three times, with one fatality

We have purposely left McBurney¹ and Collins¹⁴ as among the last to be mentioned among plural operators, despite the fact that McBurney was a pioneer He had operated six times up to 1898, in which year he published a very incomplete report of his cases Collins, his assistant, is also credited with five cases supposedly his own If, however, we compare the two reports, we see that aside from McBurney's first case in 1891, the two sets of cases, of five each, are identical To clinch the matter, the title of Collin's paper states plainly that McBurney was the operator

McBurney's pioneer case, not included in Collin's series, was accidental as far as gall-bladder surgery goes The diagnosis was carcinoma of the liver with cachexia Only the fact that the patient became no worse led finally to a laparotomy No cancer was found As patient gave a history of biliary crisis, McBurney broke away some adhesions from the atrophic and empty gall-bladder and was able to palpate all the ducts A hard mass was palpated behind the descending portion of the duodenum As the choledochus could not be exposed, the only course to pursue was to open the duodenum (Dr Briddon, in discussing this subject, said that before McBurney's operation it was the custom to leave these cases alone, as inoperable), which was done with a vertical incision of one and one-half inches Choledochus dilated and stone was extracted with forceps The duodenum was sutured but external drainage practised for two days Recovery McBurney did not operate again until December, 1896 This case ended fatally in three days McBurney ascribes death to sensitive stomach and uncontrollable vomiting Collins mentions intense meteorism No infection, no peritonitis, etc The same technic used as in the case 1891 The third operation was performed in June, 1897, and was one of multiple gall-stones, gall-bladder cystic and common duct Of interest because of partial recurrence, due to fragment of stone left behind There were two more cases for which Collins can find no documentary evidence, but he recalls their recovery The sixth case was reported in full by McBurney and somewhat resembles his first case There were likewise enlarged liver and suspicion of cancer The gall-bladder was atrophic and adherent to the duodenum The forceps were used

to dilate the ducts. McBurney operated with or without incision of the duct in his cases. In addition to these six cases, McBurney continued to operate for four or five years and brought his total up to eleven. He had no further mortality. The last five cases he never reported or caused to be reported. For a man who devised so important an operation as duodenotomy for stone, he seemed to have taken but little interest in it. His obituaries do not allude to it. His cases do not appear to have been of the desperate type often encountered.

Equally unsatisfactory is the state of the Mayos' material. In 2000 cases of biliary surgery, they are said to have done duodenotomy for stone just six times (see Hancock). One reported case seems of the simple type, and about the rest little is known, save that there was no mortality. On one occasion they did a duodenotomy for what was found to be cancer of the ampulla, the latter having been the probable diagnosis.

Of the various isolated cases reported many offer nothing worth recording, or which has not already been quoted, or which has not been amply covered in cases already quoted. Others deserve mention for some unusual complication. Certain authors lay great stress on extensive mobilization of the duodenum, drawing it onward and holding it in place with traction of sutures. Others, whatever they may do, fail to mention such extreme thoroughness. This manœuvre is necessary in the retroduodenal operation. One of the chief reasons for duodenotomy appears to be the inability to satisfactorily mobilize the gut by reason of adhesions.

Dr E. M. Miller,³⁷ who practises in Patterson City, in Louisiana, operated on a very complicated case successfully and left behind the diseased and densely adherent gall-bladder between which and the duodenum there was fistulous communication. The gall-bladder and small duct chanced to be free from stones, but these could be palpated in the common duct. A duodenotomy showed a small fistulous communication with the gall-bladder, and the stone was removed from the duct. The fistulous tract was let alone, and the duodenal wound closed.

Haasler's²² case, simple in type, presents some interest because the stone when palpated simulated a duodenal polyp.

In Theinhaus's²¹ case the gall-bladder and cystic duct were as if made of stone so great was the degree of infection. A number of stones were strung along the common duct. The author tried to attack the latter from above, splitting the duct as far down as possible, but in vain. The duodenum was sutured by the usual incision and a second one because necessary. The duct was split below and a large concretion dug from the ampulla. The posterior duodenal wall was then sutured to the split duct.

Lagurette²⁹ in a complicated case of gall-stones first evacuated the gall-bladder, and then attempted the retroduodenal operation for stone in the common duct. He mobilized the gut but could not reach the stone. He next did a duodenotomy, removed the stones, and finally extirpated the gall-bladder and cystic duct. This seems to have been a purely emergency extemporaneous procedure, as Lagurette does not mention the names of other operators.

J. C. Webster,³⁰ evidently a heavy operator, never saw but one case in which duodenotomy was the indication of necessity. The ducts were enormously distended, and a diverticulum had formed in the common duct which contained stones.

Connell,¹¹ like Webster, resorted to duodenotomies after the retroduodenal operation had failed

Hancock²¹ and others cited from literature five cases of duodenotomy for pancreatic stone, quoting Dalzell, Mayo-Robson, and Clarke Three are known to have not differed essentially from duodenotomy for choledochus stone The others presented some deviations in technic, but all may be enumerated as duodenotomies

PERSONAL CASE REPORTS

CASE I—An electrician, fifty years old, entered the hospital, March 29, 1907 Family history was negative Had been well until fifteen years ago, when he suffered a severe attack of pain in his epigastrium, followed by jaundice and a sore feeling in the stomach which lasted some days At first these attacks came frequently, but lately the intervals have been longer Some of the attacks have been followed by vomiting, lasting from three to five days A high temperature with severe chills Pain would waken him in the middle of the night, with vomiting, with relief Since October, 1906, the symptoms have been much worse and he has been compelled to give up work since the first of the present year Jaundice with a slight temperature at times, with bile in the urine, has been almost constant for the past three months No symptoms of stasis, no hæmatemesis The weight has remained about the same for the past fifteen years

Physical Examination—Left pupil slightly larger than right, both slightly irregular, but react Abdomen tympanitic, rigid, with tenderness on deep pressure in the epigastrium Greatest to the right of median line along costal border Examination otherwise negative, except the marked continuous jaundice Stomach examination Capacity 2500 c c No masses were felt over the stomach Normal in position Fasting contents 10 c c of clear fluid Guaiac negative Free hydrochloric acid Total acidity high Diagnosis Gall-stones probably in the common duct with inflammatory adhesions about the pylorus and first portion of the duodenum

Operation—Ether anæsthesia, preceded by morphine and atropine Incision through right rectus muscle, near median line with centre about one inch above the umbilicus Appendix normal Dense adhesions about the under surface of the liver and gall-bladder tract, stomach and duodenum Gall-stones were distinctly palpable, deep in the common duct An effort was made to separate the adhesions from the under surface of the liver and approach the ducts through the superduodenal space Owing to the profuse hemorrhage and slow progress, efforts in this line of attack were discontinued The duodenum, with common duct and

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stones beneath, was picked up and an incision, about an inch and one-half in length, made in the intestine, the stones palpated and pushed toward the ampulla of Vater, from which they were easily extracted. The incision in the duodenum was closed with an interlocking through-and-through continuous chromic gut suture. Over this a running suture of silk, catching only the serosa. A drainage of gauze rolled in rubber sheeting, being placed in position, the abdomen closed.

The patient made a fair recovery, jaundice rapidly disappeared, also bile from the urine lessened greatly in amount. The drainage was removed on the third day. On the eleventh day when the wound was practically closed, the patient suddenly was seized with severe pain in the epigastrium, which was followed by a profuse discharge of fluid contents of the stomach and duodenum, upon the abdominal wall. This distressing condition lasting for three weeks, when the amount gradually began to lessen and finally closed at the end of seven weeks, the patient being fully returned to health in a short time afterwards.

CASE II —A farmer, aged fifty-eight years. Family history negative. Has always been well except for the past year, has experienced a dull pain in his abdomen, at the costal margin. No radiation of pain. No acute pain anywhere. No vomiting. For the past three months there has been marked jaundice, showing in the conjunctive skin and urine. Complains considerably of heart-burn and acid stomach. Has no hunger pains. The pain being somewhat more intense after a full meal. The stools are very light in color and putty-like. No hæmatemesis or blood by rectum.

The patient is well developed and in a fair condition of nutrition. While lying flat in bed, has no apparent pain, but on slight movement of the body and exercise or work, the pain is noticeable. The abdomen is symmetrical, level, tympanitic and soft. On the left side of the epigastrium there is slight muscular spasm. Tenderness on deep pressure at the mid-point between the centre of the ninth rib and the umbilicus. Liver dulness, fifth rib in the mammillary line. Edge of the liver about two centimetres below costal border. Stomach analysis negative. Blood examination normal. Urine negative, except the presence of bile. During the past week, the patient has had a temperature ranging from 99° to 102°, with several slight chills. Diagnosis. Biliary calculi probably in the common duct.

Operation —Right rectus incision. Few adhesions. Gall-bladder thin, bluish in color. Markedly distended. Contents of gall-bladder aspirated and opened. No stones found in gall-

bladder Upon palpating the ducts, four stones about one and one-half centimetres in diameter were located On account of the success of Case I, and it seemed apparently the easiest method of approach, the transduodenal route was again selected A small incision was made through the duodenum and the stones forcibly expressed through the ampulla Little difficulty was experienced in so doing The incision in the intestine was closed with two layers of fine linen Tubular drainage placed in the gall-bladder and a small cigarette drain placed along-side of its lower end, attached by a catgut suture to the duodenum, over the incision Cigarette drain removed at the end of 48 hours Gall-bladder drain in 8 days

Recovery uneventful, no leakage from the duodenum Patient was kept on liquids, other than milk, for the first week Wound closed in 30 days

CASE III—A house-wife, aged thirty-two years, entered the hospital October 10, 1908 Family history negative Had suffered from the usual diseases of childhood No serious illness other than a comparatively mild attack of typhoid fever in 1903 For the past few years the patient suffered from severe attacks of pain in the upper abdomen, radiating to the right shoulder, accompanied by vomiting and followed by jaundice, chill and fever The attacks were of such severity and frequency that the patient had been permitted by her physician to carry a hypodermic syringe and administer morphine herself

Physical Examination—A very obese, short woman Excruciating pain upon pressure in the right upper abdomen Refused test-meal and stomach tube Urine contained much bile She urged operation at once, as the diagnosis of gall-stones had been repeatedly made by many physicians

Operation—A long right rectus incision, necessary on account of the large amount of fat Stomach and liver adherent Gall-bladder not located Stones palpated deep in the common duct Duodenal incision, extraction of three stones about one centimetre in diameter Incision in duodenum closed by two layers of fine linen and drainage with iodoform gauze, rolled in rubber sheeting

Recovery in four weeks, uneventful and no leakage from the duodenum She has remained in splendid health ever since and with the relief from the distressing condition, the morphine was soon no longer necessary

CASE IV—A house-wife, aged thirty-two years, entered the hospital, April 15, 1910 For the past five years she has suffered from attacks of pain, commencing in the epigastrium and radiating to her shoulder blade Each attack has lasted several hours and

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been accompanied by rigor and vomiting, followed by jaundice. During the past year the attacks have been more severe and frequent, the jaundice remaining during this entire period. There was tenderness on deep pressure below the right costal border. No distention of the gall-bladder could be felt. Diagnosis. Stones in the common duct.

Operation (two days later).—Right rectus incision, extensive adhesions between gall-bladder, stomach, duodenum and omentum. Gall-bladder contracted and not located. Incision through the duodenum, ampulla located and dilated. Many small stones removed from duct with a scoop. This was followed by a quantity of bile and mucous fluid. Incision in duodenum closed, double row of linen sutures, gauze drain. Disappearance of jaundice in a short time.

Report more than a year later shows her perfectly well.

CASE V—A plumber, aged forty-two, in good general health, entered the hospital, December 1, 1911. For the past four years has suffered frequently from attacks of pain over the gall-bladder. Vomiting frequently with attacks which were followed by slight jaundice. No rigor. No chill. Had been seen by a number of physicians at various times and all diagnosed gall-stones.

Operation—Adhesions of the liver, gall-bladder, duodenum and stomach. Gall-bladder distended, aspirated, stones located in the common duct, incision in the duodenum. Four stones extracted with scoop and forceps from the common duct. Rubber drain in the gall-bladder, gauze rolled in rubber sheeting placed along the duodenum.

Recovery delayed by severe ether bronchitis but eventually recovered and has remained well.

CASE VI—A business man, aged thirty-eight, entered the hospital March 5, 1911. First attack of pain five years ago, followed by attacks every month. Since 1910 the attacks have been very frequent, occurring as often as every few days. Pain very severe, radiating to the shoulder and subscapular region. Pain accompanied by vomiting and always followed by jaundice, chill and fever. A large, tender mass detected below the right costal margin.

Operation—Right rectus incision through the fibres of the muscle. Adhesions, gall-bladder very much thickened and inflamed. One hundred and twenty-five stones removed from the gall-bladder and cystic duct. Common duct blocked by several stones. The bad condition of the patient, the extensive adhesions, suggested duodenotomy. Duodenum incised, stones removed, gut sutured to duct, gut closed, tubular drain in the gall-bladder, gauze drainage to site of incision in the intestine.

Recovery good No leakage, well at the time this report was written.

CASE VII —A farmer's wife, aged fifty-eight, entered the hospital early in 1912 Diagnosis Gall-stones in the common duct had been previously made by her physician The history she gave showed frequent attacks of pain in her upper right abdomen Tenderness at the costal margin The attacks of pain were accompanied by chills and fever, and followed by jaundice

Operation —Right rectus incision, dense adhesions, gall-bladder contracted, palpable, with the fundus tilted downward into her loin Large stones palpated in the common duct, near its opening into the intestine Duodenum and the common duct, with stone included, surrounded by dense adhesions, picked up between the fore-finger and thumb of the left hand Incision in duodenum, extraction of the very hard stone, about three centimetres long by two centimetres in diameter, through the ampulla of Vater, closure of the intestine, no drainage and rapid recovery

CASE VIII —A very obese woman, aged twenty-four, wife of a station agent, was first seen at the Adrian City Hospital, June 4, 1912 History Frequent attacks of pain at the right costal border Tenderness on pressure Pain radiating to the mid-scapular region Vomiting, chills, fever, and jaundice Right rectus incision, very dense adhesions, stomach, liver, duodenum and omentum Gall-bladder probably obliterated, not located A small stone palpated through the duodenum, near the opening of the common duct, into the intestine

The dense adhesions, the fat wall, extreme difficulty with which separation of the adhesions was effected, the transduodenal method was again selected One-half inch incision was made and a small stone was extracted from the ampulla Incision closed, large pack of iodoform gauze was placed around the duodenum, as there had been considerable escape of fluid from the intestine and some hemorrhage from the separating adhesions

Recovery four weeks later Jaundice disappeared, patient remaining well afterwards

CASE IX —An iron worker, aged twenty-one, brought to the hospital, September 19, 1912, in an ambulance When seen, his condition was one of great shock, pulse almost imperceptible, temperature subnormal, surface of the body cold, face pinched, pale and covered with profuse perspiration Lips and fingers blue and respiration shallow and rapid Suffering from intense abdominal pain Morphine and saline solution were administered Examination of his abdomen revealed a large mass on the right side with

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its mid-point on a line with the umbilicus. This mass was about 20 cm long by 15 cm wide. Was well definable by the naked eye, as well as by palpation. The abdominal wall was hard and retracted. The patient had vomited profusely just prior to this attack.

From his brothers we learned that this young man had suffered from the usual diseases of childhood, had been well and a hard worker up until about one and one-half years before this illness, he had suffered from typhoid fever, after which he regained his usual health. Ten months before present illness, he had attacks of pain in his right upper abdomen, vomited, followed by fever, chill and jaundice. These attacks were frequent and often prevented him from attending to his duties for a period of a week at a time. He had vomited blood two or three times. There was no knowledge of the character of his stools. The attacks had been daily for the past week before entering the hospital. No history of hunger pains. Provisional diagnosis made of a slow perforating duodenal ulcer with abscess or possible gall-stones. The patient was in a very low state of general nutrition.

Operation two hours after entrance to the hospital. Right rectus incision. No fluid in abdominal cavity. Stomach and gall-bladder, liver and omentum adherent. Mass directly under the lower portion of the duodenum. Palpation of the mass did not reveal positively the presence of stones. Bad condition of the patient, probably stones, lead me to believe that the transduodenal method offered the only solution possible. Duodenum incised, ampulla located, pressure made on the mass, which forced from the duct, semisolid biliary material. Ampulla incised and dilated, a pint or more of partially solid stones removed. Incision closed with catgut and linen gauze drainage.

Convalescence rapid, patient gained daily, drainage removed on the fourth day. On the eleventh day the patient experienced a severe pain in his abdomen, grew cold and clammy. Stimulants administered, dressings changed, contents of the stomach and intestine upon abdominal wall. This continued for ten days more, ending in death from starvation, no food having entered the lower intestine. Gastrojejunostomy with pyloric closure would probably have saved this patient.

No one familiar with the facts will deny the difficulties encountered in dislodging a stone impacted in the diverticulum of Vater or the extraction of a stone from the superduodenal portion of the common duct, by choledochotomy. That duodenotomy is safe and rational and should be more frequently practised than appears from a study of the literature of this subject, that the operation of duodenotomy is much easier

and safer than choledochotomy where stones are located low in the ductus communis or impacted in the ampulla of Vater, I think is clear. Basing these conclusions upon a study of nine cases with only one death, these results compared with the mortality which occurred in 30 other cases of common duct stones in my work, compells me to be greatly in favor of the method of duodenotomy when indicated.

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THE MORTALITY STATISTICS OF TWO HUNDRED AND SEVENTY-SIX CASES OF ACUTE INTESTINAL OBSTRUCTION *

By JOHN B. DEEVER, M.D.

AND

GEORGE G. ROSS, M.D.
OF PHILADELPHIA

THIS study of the mortality statistics of intestinal obstruction is based upon a series of 276 consecutive cases of acute intestinal obstruction admitted to the German Hospital in the ten years ending with 1913. Some of the earlier histories were far from complete, and we have therefore used only those facts which could be found in practically all of the histories.

The etiology of the cases was as follows:

Post-operative adhesions .	81 cases
Post-inflammatory adhesions	16 cases
Strangulated hernia	156 cases
Inguinal	77
Femoral	50
Umbilical	21
Ventral	7
Subdiaphragmatic	1
Carcinoma of sigmoid	8 cases
Volvulus	5 cases
Fecal impaction	3 cases
Intussusception	2 cases
Adynamic ileus	2 cases
Congenital bands	1 case
Cause unknown or not recorded	2 cases

Of the 276 cases, 158 recovered and 118 died—a mortality of 42 per cent. One case is reported as improved, possibly one of the rare instances of spontaneous recovery or a mistaken diagnosis. The case noted as unimproved on the records probably declined operation and insisted upon discharge from the hospital.

A mortality of 42 per cent in a large series of cases of acute intestinal obstruction is not an unusually high one. It is far higher than it should be, but an analysis of the records will easily disclose very definite reasons for such an unsatisfactory state of affairs.

* Read before the Philadelphia Academy of Surgery, October 5, 1914

ACUTE INTESTINAL OBSTRUCTION

In 241 cases we found adequate records of the average time from the onset of the condition to the time of operation. In the cases that recovered it was 61 7 hours or over 2½ days, and in the case that died, 97 hours or 4 days and 1 hour. Under such conditions it is to be wondered at that so many cases had a fortunate outcome.

There is no doubt that in practically every instance, taking similar classes of cases, the time elapsing between the onset of the obstruction and the operation is the vital factor. Coley (*Keen's Surgery*, vol. iv, p. 50) states that in the first 24 hours the mortality in strangulated hernia should not be over 10 per cent, in 72 hours it becomes 50 per cent. Naunyn (*Ibid*, p. 645), in an analysis of 288 cases of ileus, states that recoveries within 48 hours were 75 per cent, but on the third day only 35 to 40 per cent recovered. Pilcher (*Medical News*, 1902) reports 40 cases of acute intestinal obstruction due to gall-stones with a mortality of 52 5 per cent.

Da Costa (*Modern Surgery*, p. 976) states that mortality in acute intestinal obstruction is 60 to 70 per cent and states also that prompt diagnosis and operation would much reduce this.

Ruge (*Archiv f. klin. Chir*, 1910-1911, xciv, pp. 711-760), in a report of Korte's Hospital cases of obstruction following appendicitis, reports a mortality of 50 per cent in early obstruction, *i e*, immediately following upon the inflammatory process, and 45 8 per cent in cases due to late or old adhesions. He reports in all 44 cases. J. V. Brown (*Surg., Gynec. and Obst.*, 1911, xii, p. 186) reaches the same conclusions as to the unnecessarily late operations in acute intestinal obstruction in a study of 59 cases in his experience. The only author whose experience seems not entirely to coincide with these facts is Woolsey (*Trans. Amer. Surg. Assoc.*, 1910, xxviii, p. 270), who in 26 cases of acute intestinal obstruction found that the average duration of the illness before operation had been rather less in the nine fatal cases than in the seventeen which recovered.

A more detailed analysis of the different groups of cases brings to light certain definite features concerning each group.

As to sex, our cases were divided fairly evenly, 144, or 52 per cent, being females, and 134, or 48 per cent, being males. Evidently complications arising from disease of the female pelvic organs slightly overbalanced the more frequent occurrence of hernia and disease of the appendix in the male.

Of special groups as regards etiology we find that hernias and post-operative and post-inflammatory adhesions furnish 253 of the 276 cases of obstruction.

There were in all 156 cases of strangulated hernia, or 56.4 per cent of the total

These were subdivided as follows

Strangulated inguinal hernia	77
Strangulated femoral hernia	50
Strangulated umbilical hernia .	21
Strangulated ventral hernia	7
Strangulated subdiaphragmatic	1

Of the 77 strangulated inguinal hernias, 57, or 74 per cent, recovered, and 20, or 26 per cent, died. Of the 50 cases of strangulated femoral hernia, 36, or 72 per cent, recovered, and 12, or 24 per cent, died. One was noted as improved, possibly spontaneous recovery or reduction; and one is noted as unimproved.

Of the 21 cases of strangulated umbilical hernia, 12 recovered and 9 died, or 42 per cent. Of the seven ventral or incisional hernias, 4 recovered and 3 died, or 42 per cent.

The higher mortality in the umbilical and ventral hernias is accounted for by the frequently observed fact that acute symptoms are often delayed and of lesser severity than in the inguinal and femoral hernias, and the indications for operations not quite as early and definite as in the other varieties of hernia.

Nevertheless, such a mortality in strangulated hernias is appalling. It is true that the average operation for an early strangulated hernia of any of the ordinary varieties does not offer great technical difficulties nor should it be attended by great mortality. The explanation is again to be found in delay before operation. It is our practice at the German Hospital to operate strangulated hernias as soon as possible after admission, the delay, therefore, as in all cases of obstruction admitted to hospitals, is before the admission of the patient. In some few instances the patient may be slow to consult a physician, but generally this is not the case.

In hernia especially the physician has a clue and guide to the cause of the symptoms in the very existence of the hernia. Oversight must be rare, except, possibly, in instances of Richter's hernia. But the hernia, while plainly indicating the source of trouble, also opens the way for delay in the operative treatment of the obstruction by giving an opportunity for an attempt to correct the condition by taxis and manipulation.

Coley gives five minutes as a safe length of time to employ taxis. Many indeed of our cases at the German Hospital have, before admis-

ACUTE INTESTINAL OBSTRUCTION

sion, been subjected to manipulations, often severe and inept, extending over many hours and even repeated upon successive days

When we consider the dangers and difficulties of taxis in strangulated hernia and bear in mind the fact that manipulation has been resorted to in practically every case before its admission to the hospital, we are justified in making it our practice to operate at once upon every strangulated hernia regardless of any other considerations. When ether or chloroform anæsthesia are not safe, local anæsthesia, and in rare cases spinal anæsthesia, will enable us to overcome this difficulty.

Although in our statistics we coincide with Coley in stating that the highest mortality in strangulated hernias is in the umbilical and ventral, our mortality in strangulated inguinal hernias (26 per cent) was slightly higher than that of the femoral (24 per cent), the reverse of what this author states. We are also able to substantiate his statement that the mortality is in large hernias and when the sac contains adherent omentum, and we believe that these two factors common to umbilical hernias are important in contributing to the high operative mortality in these cases.

Next to hernia in number are post-operative adhesions, there being in our series 81 cases, or 29 per cent, of the total number. Of the 81 cases, 41 recovered and 40 died, a mortality of 49.3 per cent. This mortality also is high and can only be accounted for by the long average time elapsing between the onset of the disease and operation. While the symptoms of strangulation of a femoral or inguinal hernia are fairly well known to the physician, it would seem that in other cases of intestinal obstruction terminal symptoms only are recognized. It is true that usually a case of obstruction has been diagnosed as colic, acute gastritis, or enteritis, and that a diagnosis of intestinal obstruction is not made until we begin to have the symptoms of toxæmia, peritoneal inflammation and persistent vomiting, often fecal.

In a small percentage of the cases the obstruction occurred during convalescence and while the patient was still in the hospital, when the diagnosis could be made early and treatment promptly instituted. The average time from the first operation to the obstruction was two years and three months. The longest period intervening was twenty years (following a hysterectomy).

Of the 81 cases of post-operative adhesions, 51 followed operations for appendicitis and 44 of this series had had drainage at the original appendiceal operation. Each drainage case can safely be held to mean a case in which operation was delayed beyond the time of election. In line with endeavors to prevent instead of treating avoidable surgical

conditions, nothing is more important than to forestall the development of pus within the peritoneal cavity. Of the 51 cases, 27 died. A large percentage at least of these patients would never have had adhesions or the consequent obstruction had they been operated upon early in the appendiceal attack and had drainage not been necessary.

Seventeen cases are stated to have been due to post-operative adhesions, the primary cause not being given.

Fourteen followed operations upon the female pelvic organs, hysterectomies, salpingo-oophorectomies, etc. A certain number of such cases are now doubtless avoided by the greater care exercised in covering raw surfaces, stumps, etc.

Post-inflammatory adhesions were 16 in number. The term is used to designate new adhesions from an inflammatory or peritonic process. Of these 11 died, a mortality of 68.7 per cent. This is partly due to the weakened and septic condition of the patients at the time of operation and partly due to the difficulty of diagnosis. Our results must always be in question in these cases. Our only hope is in minimizing the cases of peritonitis and of resulting obstruction. Most of such cases occur after operation for appendicitis in its later stages.

A more difficult post-operative condition to explain is adynamic ileus, of which there were 2 cases, one recovering and one dying. In the absence of a septic cause excessive handling of the viscera may be held to account for it. A more probable explanation is the occurrence of a thrombosis of the mesenteric veins.

There were three cases of fecal impaction with two deaths, a mortality of 66⅔ per cent. Fecal impaction generally occurs in elderly people and often much time elapses before operation. The onset and course are more or less insidious and the patients have usually been treated vigorously by purges, starvation, enemata, etc. Moreover, operative intervention very occasionally leads to enterostomy and colostomy, and this in itself is an unfavorable factor. One case of acute obstruction is recorded as having been caused by congenital bands. Of late years so-called "congenital" bands have received an increasing amount of attention. We believe that bands of extent great enough to produce obstruction are rarely congenital—that they are practically always due to subacute or unrecognized attacks of peritonitis.

There were five cases of volvulus, of which three recovered and two died, or 40 per cent. This is a condition not very frequent and generally not definitely diagnosed before operation. The sudden onset and rapid development of symptoms, however, are always sufficient to

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make clear the fact that some abdominal catastrophe demanding surgical intervention has occurred

The same is true of intussusception in adults, of which there were two cases in this series, one recovered and one died. The case which recovered was a most interesting one. The intussusception occurred during typhoid fever, was correctly diagnosed and promptly operated. It has been elsewhere reported by one of us in conjunction with Dr H F Page (*Amer Jour Med Sci*, December, 1907).

There were eight cases of acute obstruction complicating carcinoma of the sigmoid. It is not to be expected that in such cases recovery could occur.

Taken as a whole, numbers of cases in which adequate records were kept show certain interesting points in symptomatology. In 63 cases, from 1908 to 1912 inclusive, with records of the vomiting, there were 35 recoveries and 28 deaths. In the cases recovering 5 only had reached the stage of fecal vomiting, but the average length of time the patients had been vomiting was two days and one hour. Of the 28 cases dying, 14 had fecal vomiting and 14 non-fecal vomiting only. The average duration of the vomiting had been two days and sixteen hours.

It would seem almost impossible that a patient with persistent uncontrollable vomiting with other symptoms of obstruction should be allowed to continue ill for over two days without a diagnosis or appropriate treatment.

In ninety cases, 1908 to 1912 inclusive, in which a record was kept of the fecal evacuations, 52 were cases that recovered and 38 died. In the recovered cases bowel movements had been absent on an average for two days and twelve hours and in those that died, three days and five hours. These figures point, as do the previous ones, to inexcusable delay, for in practically every case vigorous means had been adopted to produce an emptying of the bowel. Here we may well sound a note of warning against misinterpreting evacuations of the lower bowel only as a result of enemata, especially when the colonic contents are emptied by a high enema.

A review of the entire mass of statistics upon this series of cases makes it evident that in almost every instance, in spite of symptoms so plain as to be pathognomonic, diagnosis has been tardy and operation delayed. Prompt diagnosis and immediate operation will reduce the mortality in acute intestinal obstruction to a mere fraction of that encountered at present.

PRESERVATION OF THE ILIOHYPOGASTRIC NERVE IN OPERATION FOR CURE OF INGUINAL HERNIA *

BY CHARLES N. DOWD, M D

OF NEW YORK

SURGEON TO THE ROOSEVELT HOSPITAL

WHEN in 1890 Bassini described his operation for the cure of inguinal hernia, he established an epoch in the treatment of that condition. The splitting of the aponeurosis of the external oblique muscle is an essential part of his procedure, for it enables the operator to ligate the sac at a high level and to properly approximate and suture the structures which form the posterior wall of the reconstructed inguinal canal.

Bassini's operation, or some allied procedure which entails a similar exposure of the tissues, has been very generally adopted by surgeons. The splitting of the external oblique aponeurosis is even practised by those surgeons who believe that the essential step in operation is the high ligation and ablation of the sac, and that suturing the underlying tissue is unnecessary. This is exemplified by Murray,¹ of Liverpool. In operating upon children, some surgeons do not split this aponeurosis, since they believe that in these little patients a sufficiently high ligation of the sac is possible without it, this exception, however, is not important, in the vast majority of hernia operations this aponeurosis is split so as to obtain suitable access to the subjacent tissues.

The improvement in results which has accompanied the adoption of the modern methods of operation for hernia has been remarkable. In 1886, Wood² reported 27 per cent of relapses and, in 1890, Bull³ reported 36 per cent and advocated the abandonment of the term "cure," as then used.

While in using the modern methods, Bassini,⁴ Judd,⁵ Coley and Bull,⁶ and Murray¹ report, respectively, 28 per cent, 25 per cent, 8 per cent and 17 per cent of recurrences. If we study hospital operation records, we find confirmatory evidence. For instance, there have been 1020 operations for hernia in Roosevelt Hospital since January, 1910. Only 12 of these hernias were recurrences, and in only 2 of the 12 had previous operation been done at that institution. These results surely justify the modern procedure, and we may be well assured that

* Read before the New York Surgical Society, November 11, 1914

the splitting of the external oblique aponeurosis and gaining access to the subjacent tissues is a well established surgical procedure

Although the percentage of recurrent hernias is small, the total number of hernia operations is now very large. In the month of October, 268 operations for hernia were posted on the bulletin board at New York Academy of Medicine, in a total of 2697 operations, thus indicating that nearly 10 per cent of the surgical operations of the present time are done for the relief of hernia. When we consider this vast number of operations and the evident fact that the rate of recurrence among operators at large must be greater than that above recorded, we must appreciate that there are enough recurrences to be worthy of careful study.

It is notable that a large proportion of relapses come in the form of direct hernias. Judd⁷ writes of the relapses coming just above the pubic bone. Four of Bassini's seven recurrences were direct, the form of the fifth was not stated and the remaining two are referred to as "bulgings," not true hernias. Downes,⁸ in studying cases with recurrent hernia who have applied for relief at The Hospital for Ruptured and Crippled, states that a large proportion of them are "direct." The majority of the recurrences which the writer has seen have been in the form of slight "direct" bulgings. One would naturally expect this since the operation for the cure of hernia should leave the region of the internal ring better protected than the lower part of Hesselbach's triangle.

With these considerations in mind we may well ask whether there are any special precautions which should be practised and taught. There are at least two considerations

- 1 Adequate suture
- 2 Preservation of nerve supply

Adequate Suture—Much attention has been given to this subject, Coley⁹ says: "I believe the lowermost suture is one of the most important in the series. My own practice is to insert the suture in such a way as to include the reflected portion of the external oblique aponeurosis as well as the conjoined tendon and the transversalis fascia." He puts 4 or 5 stitches behind the cord. When the conjoined tendon and the fibres of the internal oblique and transversalis muscles are weak and attenuated—a condition which has been especially studied by Blake,¹⁰ Bloodgood¹¹ and Downes—it is advantageous to bring down a part of the rectus muscle and possibly to liberate a portion of the internal oblique from the transversalis fascia so as to make a reinforced suture line possible.

Preservation of Nerve Supply—The accompanying drawing (Fig 1), which is adapted from Spalteholz, shows the nerve supply of this region

The twelfth dorsal, the iliohypogastric, and the ilioinguinal nerves curve around the lower part of the back and abdomen. They contain both motor and sensory fibres and supply the muscles, peritoneum, fascia and skin. The iliohypogastric nerve is situated between the other two and communicates with them in various places—when it is large, they are small, and when it is small they are found to be proportionately enlarged. They give off motor fibres to the transversalis, internal and external oblique and rectus muscles, and influence the nutrition of the parts which they supply.

Your attention is especially called to that part of the iliohypogastric nerve which crosses the field of operation as exposed by the splitting of the external oblique aponeurosis. Fig 2 illustrates this.

In incising and turning back this aponeurosis, two nerves may be found,—the ilioinguinal usually lies well down toward Poupart's ligament and can easily be avoided, moreover, it emerges at the external abdominal ring and is distributed to the integument of the scrotum and upper and inner part of the thigh and, hence, has very little importance.

The iliohypogastric nerve,¹ however, runs directly across the operative field. During a period of several years I have had the opportunity of seeing a great many hernia operations done by many operators and am confident that this nerve is frequently cut. This cutting is usually unimportant but it may be very important in the small proportion of cases who are likely to have recurrences, and they are the ones under consideration in this paper. The nerve is generally large enough to show very distinctly. It runs into the aponeurosis of the external oblique.

* This nerve has been studied in detail from various view-points. The flat abdominal muscles are supplied by the lower five intercostal nerves, the iliohypogastric and the ilioinguinal, thus obtaining localized action in different parts of the muscle. Fibres are given off from these nerves as they course through the muscles. These fibres can be seen if careful dissection is made. They were dissected and seen in the wound area before this paper was written. Since then sterilized faradic electrodes have been applied to the nerve during operations and localized contraction has been obtained in those parts of the internal oblique and transversalis muscle which are used in the reconstruction of the posterior wall of the inguinal canal. Serial microscopical sections have also been made and they show the small fibres of the nerve between the muscle bundles near the main trunk.

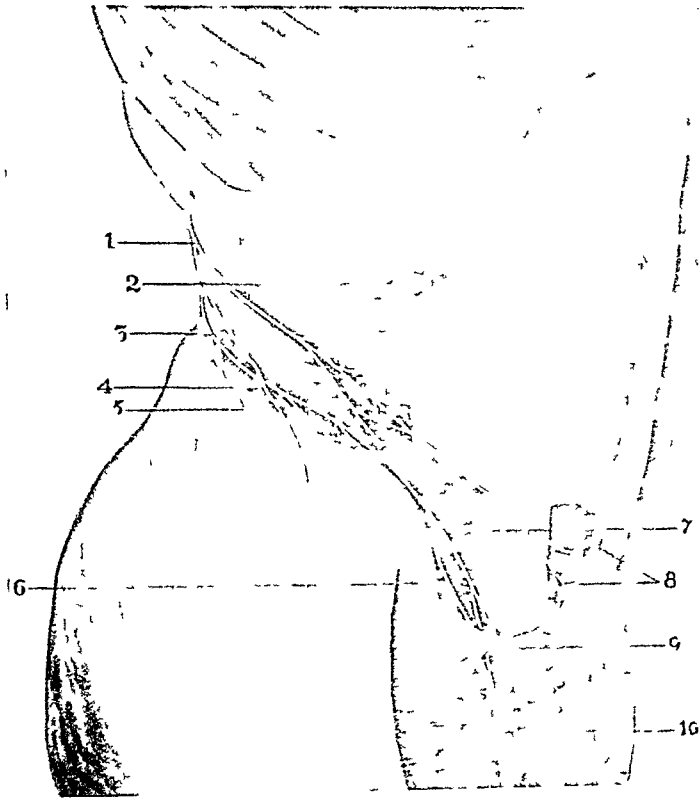


FIG 1 —Nerve supply of the lower part of the abdominal wall (adapted from Spalteholz)
 1, N intercostalis XII, 2 M transversus abdominis, 3 N iliohypogastricus 4 ramus muscularis,
 5 ramus cutaneus lateralis n iliohypogastrici, 6 N ilioinguinalis 7 M obliquus internus abdomi-
 nis, 8, rami cutanei anteriores n intercostalis XII, 9 annulus inguinalis subcutaneus

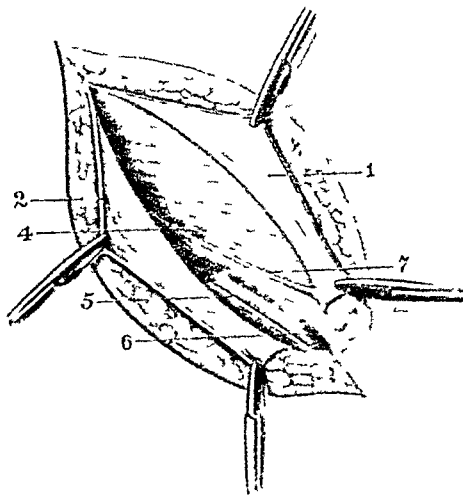


FIG 2 —1, aponeurosis of external oblique muscle turned upward, 2 aponeurosis of external
 oblique muscle turned downward, 4, internal oblique muscle, 5 ilioinguinal nerve, 6, cremaster
 muscle, 7, iliohypogastric nerve

ILIOHYPOGASTRIC NERVE IN INGUINAL HERNIA

muscle about an inch above the external abdominal ring Those fibres which supply sensation to the skin are unimportant, but those which are distributed to the external oblique aponeurosis, the internal oblique and transversalis muscles, and to the transversalis fascia may be important at the time when healing is taking place

It always seems an anomaly that the internal oblique and transversalis muscles and transversalis fascia should form a permanent union with Poupart's ligament Such union is denied by some surgeons Many of us, however, when operating for recurrent hernia, have seen it throughout at least a large part of the suture line But if we are to expect a good union between these "alien" elements, we should surely leave them all the vigor that we can and should not weaken them during this period of healing by depriving them of their natural nerve supply

The nerve may be easily seen and avoided,—it is usually best to make the first opening in the aponeurosis by a knife cut, $1\frac{1}{2}$ inches above and external to the ring, and then slip curved scissors through this opening and push nerve and muscle well back before proceeding with the incision.

Little attention is given to the subject of nerve injury in the descriptions of hernia operations, and the ilioinguinal and genitocrural nerves have received much more than their share of this scant notice They are much less important than the iliohypogastric

An incision through the aponeurosis above the external ring, instead of through it, has been advocated; in this incision, the nerve supply may be conserved, but, on the contrary, it may be sacrificed

In lapping the aponeurosis of the external oblique, as is done in several forms of operation, it is possible to interpose an aponeurosis which is a serious bar to the reunion of severed nerve fibres

Summary—A terminal branch of the iliohypogastric nerve of considerable size is exposed in the operation for inguinal hernia when the aponeurosis of the external oblique muscle is split and laid open This branch is easily severed or otherwise injured in the operation This injury is usually unimportant Since, however, security against relapse of the hernia depends in large part on the vitality of the parts to which this nerve goes, its injury should be avoided

The percentage of recurrences after operation for the cure of hernia is small, but the total number of recurrences is considerable since so many operations are done In the effort to lessen the number of relapses, proper suturing is more important than the preservation of the nerve, but the nerve surely has a definite influence and should not be sacrificed

CHARLES N DOWD

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COMPLETE FRACTURE OF THE LOWER THIRD OF THE RADIUS IN CHILDHOOD, WITH GREENSTICK FRACTURE OF THE ULNA *

BY PENN G SKILLERN, JR, M D

OF PHILADELPHIA

INSTRUCTOR IN ANATOMY AND SURGERY, UNIVERSITY OF PENNSYLVANIA

WHILE fractures of both bones of the forearm in childhood are frequent and well-recognized, there is one variety that, in its mechanism, site, and characteristics, is as definite a clinical entity as is Colles's fracture, and yet it has not been differentiated in the text-books or in the literature from the other indifferent fractures of the forearm. I refer to complete fracture of the radius with incomplete greenstick fracture of the ulna in the lower third of their shafts (Fig 1). The cause is quite constantly a fall *while in motion*, most commonly either off skates or a bicycle. The deformity consists of displacement of the lower fragment of the radius to the dorsum and laterally, and bending of the ulna with concavity toward the radius, the radial portion of the fibres of the ulna at its site of fracture being compressed but not torn asunder, the inner fibres only being separated. I shall endeavor to show that about this peculiar and characteristic incomplete greenstick fracture of the ulna hinges the maintenance of the displacement, and also the correct method of reduction. The following two cases are typical.

CASE I—H H, male, aged fourteen years, school-boy, white, presented at the Surgical Out-patient Department of the University Hospital (Case record 40,201) on April 2, 1914, with the history of having fallen two days previously, *while skating*, upon the outstretched right forearm.

Clinical Diagnosis—Fracture of radius and ulna shafts, lower thirds, that of the radius being complete and with displacement, and that of the ulna being incomplete and with diminution of the normal external concave curve. Skiagram showed for the radius in the anteroposterior view a transverse dentate line of fracture $1\frac{1}{8}$ inches above the epiphyseal cartilage, with lateral shifting of the distal fragment, one-third diameter, and in the lateral view, displacement of the same fragment dorsally, two-thirds diameter; and for the ulna a transverse greenstick line *incomplete externally*, at a higher level ($\frac{7}{8}$ inch) than that of the radius, and with bowing of the ulna concave externally (Figs 1 and 2).

* Read before the Philadelphia Academy of Surgery, October 5, 1914

A study of this fracture in the skiagram not only reveals the mechanism of production, but also furnishes a clue to the mechanism of reduction. The deformity leads one to anticipate difficulties in complete reduction, but it is very simple. In the first instance, it is evident that the brunt of the vulnerating force was borne by the radius, whose fracture is complete, and that there was sufficient force remaining to produce the greenstick fracture of the ulna. The inner fibres of the ulna were ruptured by tensile stress, whilst the outer fibres underwent compressive stress, the force thus stopping short of causing a complete fracture of this bone. *These intact outer fibres of the ulna maintained the position the bones were in when the force ceased to act, and therefore presented the chief obstacle to reduction.* It is patent that in order to reduce the fracture, attention must be directed chiefly toward overcoming the vicious bowing of the ulna, and that this can be accomplished only by rupturing the still intact outer fibres, so that alignment of the inner border of the ulna may be restored, which means conversion of the greenstick into a complete fracture. This having been done, *the radial fragments, aided by a little pressure, will reduce themselves automatically.* Acting upon this analysis of the fracture, the complete reduction of the fragments, as shown in the second skiagram (Figs 3 and 4), was attained. The criterion of reduction, then, must be the restoration of the alignment of the inner border of the ulna.

CASE II — H. M., male, aged thirteen years, school-boy, white, presented at the Surgical Out-patient Department of the Hospital of the University of Pennsylvania (Case Record 41,221) on July 22, 1914, with the history of having tripped five days previously down three steps, turning a somersault, and landing upon right forearm.

Clinical Diagnosis — Complete fracture in lower third of radius with displacement, and greenstick fracture of ulna at a slightly higher level. Skiagram showed for the radius in the anteroposterior view (Fig 5) a transverse dentate line one inch above the epiphyseal cartilage, with displacement of upper end of distal fragment laterally, one-third diameter, and in the lateral view (Fig 6) displacement of upper end of distal fragment dorsally one-half diameter. The ulna showed in the anteroposterior view a transverse greenstick line $1\frac{1}{2}$ inches above the epiphyseal cartilage, *incomplete externally*, and slight bowing of distal fragment with concavity toward radius. In the lateral view there is no displacement.

Under nitrous oxide gas anæsthesia the greenstick fracture of the ulna was made complete, the outer, unbroken fibres rupturing



FIG 1—Type of "special" fracture of radius and ulna (anteroposterior view) The radius is involved by a transverse dentate line $1\frac{1}{8}$ inches above the epiphyseal cartilage The distal fragment is shifted laterally one-third diameter The ulna is involved by a transverse greenstick line incomplete externally, at a higher level ($\frac{3}{4}$ inch) than that of the radius and with bowing concave externally See Case I



FIG 2—Lateral view of radius and ulna in Case I The distal fragment of the radius is displaced dorsally two-thirds diameter There is slight dorsal displacement of the ulna



FIG 3—After reduction (anteroposterior view) Note complete rupture of outer fibres of ulnar fracture with consequent straightening of inner border of ulna and automatic shifting of displaced distal fragment of radius into good position Compare with Fig 1



FIG 4—After reduction (lateral view) Fragments reduced to their normal position Compare with Fig 2



FIG 5—A second typical case of "special" fracture of radius and ulna (anteroposterior view). The description corresponds to that of Fig 1 although both bones are fractured at a more distal ($\frac{1}{8}$ inch) level. By placing a ruler along the inner border of the ulna the outward bowing of this bone distal to the seat of fracture is accentuated. See Case II.

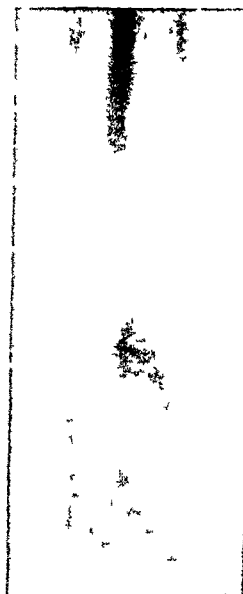


FIG 6—Lateral view of radius and ulna in Case II. Note dorsal displacement of distal fragment of radius $\frac{1}{2}$ diameter with greater angulation than in Fig 2. No displacement of ulna.



FIG 7—After reduction, anteroposterior view. Again the outer fibres of the ulnar fracture have been completely ruptured with the result that the alignment of the inner border of the ulna has been restored and the displaced radial fragment shifted into place. Restoration of alignment of inner border of ulna may be demonstrated by a ruler. Compare with Fig 5.

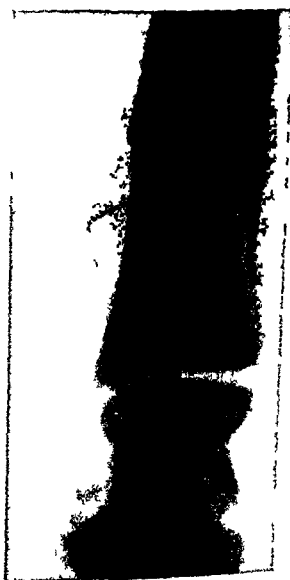


FIG 8—After reduction lateral view. Distal fragment of radius still angulates slightly backward but this was corrected with ease at the next dressing. Compare with Fig 6.

FOREARM FRACTURES IN CHILDHOOD

with an audible snap. The fragments of the radius adjusted themselves automatically into place. Two splints were applied, a volar bond and a dorsal straight, and the forearm was placed in a triangular sling. Skiagram (Figs 7 and 8) showed that reduction was complete, *the alignment of the inner border of the ulna having been restored*.

This case was so similar to the first case in the mechanism of production, the findings, and the mechanism of reduction, that I looked over our records to gauge its frequency. A study of these previous cases, together with a closer investigation of cases reporting subsequently forced me to the conclusion that here *we are dealing with a fracture fully as characteristic and significant as Colles's fracture in adults*. In other words, this fracture is to childhood what Colles's fracture is to adults. Colles's fracture is comparatively rare in childhood, having been found in but four per cent of cases in this series, and occurs at an older age than fracture of both bones in their lower third.

Malgaigne recognized that greenstick fractures are more common in the forearm than elsewhere, and are usually due to a fall upon the hand. The importance of reduction is exceptionally great, not only from the stand-point of epiphyseal growth, but also from that of rotation of the radius, which may be easily destroyed by displacement or non-union. The teaching that a bad anatomical result does not always imply a bad functional result is baneful, for it furnishes an excuse to be satisfied with inferior anatomical reduction. On the contrary, the idea expressed by Mr. Robert Jones, of Liverpool, that a bad anatomical result gives good functioning in only 29.7 per cent, but that a good anatomical result gives good functioning in 90.7 per cent of cases, is to be endorsed. The same authority also advises that, in addition, the bones be restored to their normal curve. Despite these strong arguments in favor of completing incomplete fractures so as to restore proper alignment, there are some, Cotton among others, who consider it unnecessary, and that it makes it harder to maintain the fragments in the correct position. To this there may be added the theoretical objection that the periosteum might be ruptured or torn up, and that osteoblasts might grow along the blood clot out into the muscles, produce exuberant callus, and subsequently interfere with function. These objections may be met with the observations that many fractures are complete from the beginning, and often show considerable displacement, as in the radius in my case, yet healing without exuberant callus results, that in childhood the periosteum is thicker and tougher than in adults, and hence less liable to be torn, and that, when properly reduced, it is not hard to maintain the

fragments in the correct position—not even so hard as when the fractures are complete from the beginning, since the grip of the greenstick fracture, together with the unruptured periosteum, tends to prevent wide excursion of the fragments from each other during reduction. Of course, in fractures as well as in luxations, it is inadvisable to use an undue amount of force in the act of reduction, for extensive damage might be done.

ANALYSIS OF CASES—One hundred cases of fractures of the radius and ulna in childhood in which the histories were carefully kept were selected from the records of the Surgical Out-patient Department of the University Hospital between January 1, 1912, and September 1, 1914, and afford a fairly rich assortment for study.

Season—Sixty per cent occurred in the summer months, from May to August, inclusive. In the Spring, bicycles, skating and running become popular. In June and July young human beings revert to the type of their arboreal ancestors coincident with the appearance of luscious cherries upon trees. With the opening of public playgrounds falls from swings furnish many cases. Twenty per cent occurred in each of the remaining periods of four months, sledding being a contributory factor.

TABLE I

TABLE SHOWING FREQUENCY ACCORDING TO MONTHS AND SEASONS

January	3	May	10	September	8
February	6	June	10	October	6
March	5	July	28	November	4
April	6	August	12	December	2
Total	<u>20</u>		<u>60</u>		<u>20</u>

Age—More than two-thirds occurred from nine to fourteen years of age, inclusive. This is the period of greatest and roughest activity in childhood. Both bones and the ulna alone were broken in younger children, while fractures of the radius alone or disjunction of its lower epiphysis occurred on an average in older ones.

TABLE II

TABLE SHOWING FREQUENCY ACCORDING TO AGES

2	1	9	13	15	4
3	3	10	7	16	3
4	3	11	11	17	4
5	1	12	13	18	0
6	5	13	11	19	1
7	4	14	14		
8	2				
Total	<u>19</u>		<u>69</u>		<u>12</u>

FOREARM FRACTURES IN CHILDHOOD

Sex —Four-fifths of the cases occurred in boys, in keeping with their rougher methods of play

TABLE III

TABLE SHOWING FREQUENCY ACCORDING TO SEX	
Males	81
Females	19

Cause —Fractures of the upper extremity in general and the forearm in particular are the penalty of the erect attitude, and of atrophy of the prehensile function of the forelimb. It seems best to distinguish two classes of falls, those with which momentum is strongly associated, and those in which it is an insignificant factor, the attraction of gravity predominating. In the latter class falls from a height may be given special prominence. A study of these cases shows that the special fracture of the lower third of the radius and ulna, the basis of this paper, is particularly associated with the momentum gained by bicycling, skating, swinging, running, horseback-riding, motoring, and pole-vaulting. Those in which the force is more purely the attraction of gravity are falls from steps, porch or fence rail, chair, bed, high-jump, or merely slipping and falling upon hyperextended, less often hyperflexed, hand. Falls from a height include those from a tree, pole, ladder, or haystack.

Site —As in adults, the lower third of the radius is most frequently fractured. In this series the lower third of both bones or of the radius alone comprised 70 per cent of the fractures. This circumstance and the fact that the radius in childhood is usually fractured above Colles's site (which is usually taken at from one to one and one-half inches above the lower articular surface of the bone) may be explained in part by the statement of Rixford (*Jour. A. M. A.*, 1913, lx1, 916), that in the long bones of children the medullary canal is smaller than in adults and is especially undeveloped toward the ends, and that the compact bone of the shaft becomes thin much farther from the ends than in adult bones and the cancellous bone extends correspondingly farther from the epiphyses. The following table has been compiled to show the mechanism according to the site of fracture.

The most significant feature of this table is the frequency with which the radius and ulna are both fractured in their lower third, this site being involved in 32, or almost one-third of the cases. Of these 32 cases, thirteen, or almost 50 per cent, conform to the type to which special attention is called in this paper, namely, complete fracture of the lower third of the radius with dorsal and lateral displacement and greenstick fracture of the ulna incomplete on its radial side and with bowing

TABLE IV

TABLE SHOWING MECHANISM ACCORDING TO SITE OF FRACTURE (See Figs 9-13)

No Cases	Site	Gravity Without Momentum	Gravity With Momentum	Falls From Height	Cause Not Given
4	Both bones, upper third	3	1	0	0
14	Both bones, middle third	7	6	0	1
32	Both bones, lower third	15	11	6	0
6	Radius, lower third, and ulna, styloid	2	2	0	2
3	Radius, upper third (neck 2, shaft 1)	2	0	0	1
3	Radius, middle third	1	2	0	0
16	Radius, lower third	9	4	2	1
16	Radius, disjunction of lower epiphysis, and fracture of ulna, styloid tip (2)	5	4	3	4
6	Ulna	4	1	1	0
100		48	31	12	9

of the lower fragment of the ulna over toward the radius, the displacement of whose lower fragment it thus maintains In fact, *this special fracture comprises 13 per cent of all fractures of the radius and ulna*

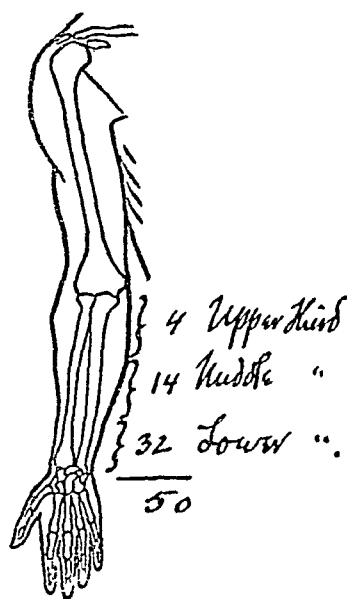


FIG 9—Fractures of radius and ulna (thirds)



FIG 10—Fracture of radius (lower third) and ulna (styloid process)

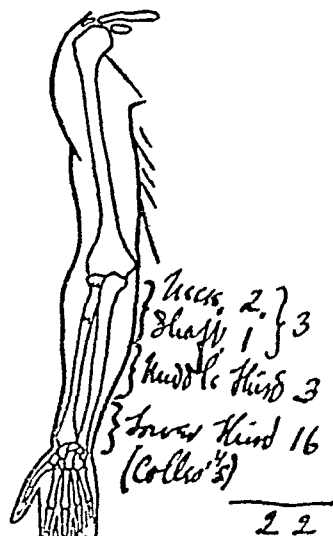


FIG 11—Fractures of radius (thirds)

in this series Of these thirteen special fractures at least eight, or almost 66 per cent, were caused by gravity *with* momentum In the remaining five the nature of the fall unfortunately is not stated in two, was direct

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violence in two others, and a fall from a ten-foot ladder in the remaining case. Hence, it may be stated that this special fracture is typically *the resultant of the action of gravity with momentum*. A study of the non-typical fractures at this site shows in a general way that falls upon the hyperflexed hand are apt to result in "buckling" fracture of both bones, by which is meant telescoping of cancelli with bulging about the circumference of the fracture and without displacement, that falls upon the hyperextended hand are apt to result in ordinary greenstick fractures of both bones with angulation, and that falls from a height are apt to produce complete fractures of both bones with greater displacement.

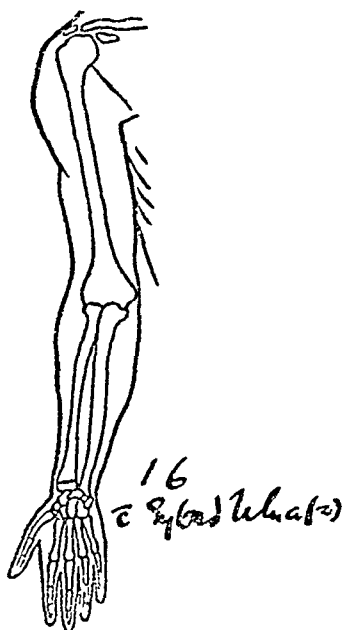


FIG 12 —Epiphyseal disjunction,
lower end of radius

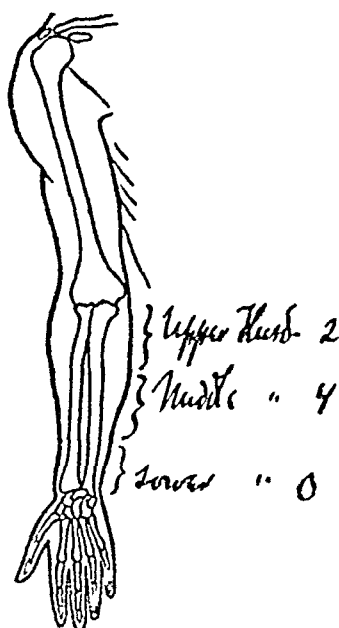


FIG 13 —Fractures of ulna

Hence, *knowing the mechanism of the fall enables one to predict with a fair degree of certainty the nature of the injury to the bones*, and I have thus diagnosed the injury in many cases from the history alone. In the smaller number of cases in which the radius is fractured in its lower third alone or in conjunction with separation of the tip of the ulnar styloid the same rules of cause and effect hold good. In the last analysis the extent of fracture hinges upon the intensity of the vulnerating force, and it must be borne in mind that minuter details of mechanism could be elicited if the observer were to see the patients actually falling.

In the sixteen cases of disjunction of the lower epiphysis of the radius all these mechanisms were exemplified. This injury occurs on an average at a later age than the fractures we have been discussing. It is diagnosed clinically by the site of the displacement, if any exist. There

may have been displacement which was reduced by the patient, in which case the history is of great diagnostic importance, and the skiagram being negative is really of positive value. In two of these cases the tip of the styloid process of the ulna was avulsed. There was one case of para-epiphyseal strain, in which injury the epiphysis is partially separated, and one of para-epiphyseal sprain, in which the epiphysis is completely separated but not displaced. These types of injuries conform with the well-known classification of Ollier, and may be diagnosed by the site of "wincing" tenderness, the absence of deformity or of history of deformity, and the skiagram, which shows a widening of the epiphysis, and later on callus formation about the site of injury. Epiphyseal injuries must always be suspected in children and adolescents and carefully reduced and treated just as a fracture, lest there arise deformity in the growth of the bone.

The diagnosis of an injury to the forearm should always be made by careful clinical investigation. It is a great mistake in more than one way to depend exclusively upon the skiagram. *A skiagram must be considered merely as one of the many signs of fracture.* There are two factors which will diagnose 90 per cent of fractures of the forearm clinically. One is a thorough understanding of the mechanism obtained from a careful history, and the other, "wincing" tenderness. It has been shown that a given mechanism is apt to produce a certain fracture. This, in turn, indicates where to examine for "wincing" tenderness. I use the term "wincing" because more expressive than the adjective "localized." When the site of fracture is reached moderate pressure with a finger tip causes the patient to *wince*—he screws his face up and involuntarily withdraws his arm. This is almost pathognomonic of fracture.

There is another feature to which I believe attention has not hitherto been called. I have recently seen several cases of fracture in childhood in which I was positive of the existence of a fracture on clinical grounds, but in which skiagrams taken from all aspects were apparently negative. Not having been satisfied I decided to await the usual period of callus formation and then have other skiagrams taken, in the meantime treating the cases as fractures. In these several cases I had the satisfaction of seeing typical callus produced. In the first case I wondered if this were a traumatic osteoperiostitis, but my doubts were allayed by the second case, in which there was a complete fracture with callus in the lower third of the radius while the ulnar callus showed only along the radial border of this bone, at a location where it is obvious that traumatic osteoperiostitis could not occur, especially seeing that the injury was produced by indirect violence. Minute scrutiny of the skiagrams now

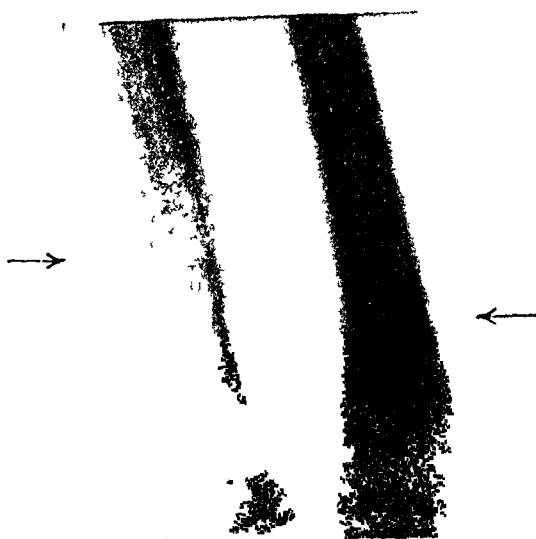


FIG 14 —The method of diagnosing "first degree" greenstick fractures patent clinically but obscure in skiagram by awaiting callus formation. The radial border of the ulna, between the two arrows, shows a strip of callus formation, the lower arrow showing, on close scrutiny, a greenstick fracture. Note callus on radius. Skiagram taken 40 days after injury.

revealed a very faint transverse line, perhaps only a few torn cancelli, whose site corresponded exactly to that of the clinically-elicited "wincing" tenderness (Fig 14). In interpreting this faint line defects in the plate were carefully excluded. I believe that here we are dealing with the first degree of a greenstick fracture—a degree attained by the vulnerating force ceasing to act after it had torn a few cancelli, whereas further action of this vulnerating force would have produced the typical bending greenstick fracture. These cases also emphasize the accuracy of "wincing" tenderness, and its value as an indicator of where to look on the skiagram for a fracture. I believe I present good reasons for considering a skiagram a secondary sign of fracture that is surpassed in value by a careful history and the eliciting of "wincing" tenderness.

I believe that fractures of the radius and ulna or of either alone in childhood are best treated according to the following plan. If reduction be indicated, nitrous oxide gas should be administered for reasons stated above. Attempts at reduction must be repeated until the skiagram shows a satisfactory result. The criterion of reduction of a Colles's fracture or an epiphyseal disjunction is the restoration of the carpal articular surface of the radius to a plane that lies at right angles with the long axis of the forearm. Splints of the proper size are fashioned for the individual case from stout pine board. It is my custom to have at hand for this purpose a stock of boards in lengths and a sharp carpenter's saw. The splints are well padded with non-absorbent cotton, which is retained by a muslin bandage secured by a pin. The padded splint is applied to the forearm and retained, not by plaster, but by a *muslin* bandage. In applying this bandage the first turns are the loosest and the final turns the tightest. The bandage is secured by pins or adhesive strips. The forearm is always bandaged at right angles to the upper arm, lest the upper edge of the bandage cut into the antecubital fossa. A triangular sling is then applied. For fractures of both bones in the upper two-thirds the mid-prone position is liable to result in sagging of the fragments toward the ulnar side, an undesirable circumstance that may be obviated by the position of full supination. The patient reports the next day to insure against ischæmic contracture, and the parent is directed to watch the circulation of the limb by noting the color, temperature, and occurrence of pain, and bring the child around immediately upon the appearance of these disturbances, for it is known that ischæmic contracture may develop within a very few hours. Massage and passive motion are prescribed for the individual case, and the splints removed as soon as firm union is present.

CONCLUSIONS —(1) There is a fracture of the lower third of the

TABLE V *
TABLE OF ONE HUNDRED CASES OF FRACTURES OF THE BONES OF THE FOREARM IN CHILDHOOD
Group 1 Fracture of Radius and Ulna in Upper Third 4 Cases

Case	No of Case Record	Sex		Age	Nature of Fall	Right	Left	Greenstick		Complete		Displacement	Remarks
		M	F					Radius	Ulna	Radius	Ulna		
1	36184		+	2	From steps		+	+	+			Angulation Of radius Angulation of ulna	Dressed in full supination Internal angular splint
2	39755	+	+	13	Upon forearm		+	+	+	+	+		
3	41263	+	+	10	Upon extended hand	+	+	+	+				
4	35301			12	From bicycle		+	+	+				
	4	3	1			1	3	3	3	1	1	3	

Group 2 Fracture of Radius and Ulna in Middle Third 14 Cases

Case	No of Case Record	Sex		Age	Nature of Fall	Right	Left	Greenstick		Complete		Displacement	Remarks
		M	F					Radius	Ulna	Radius	Ulna		
5	39275	+		9	Jump from tree stump	+		+	+			0 Of radius	Dressed in full supination Dressed in full supination
6	35114	+		17	While running	+				+	+	+	
7	36264	+	+	11	Downstairs		++			++		Slight volar angulation Angulation of ulna Slight dorsal angulation	
8	36892	+	+	9	From skates		++	++	++				
9	36078	+		9	Upon forearm		++						
10	36266	+	+	3	From chair		++						
11	38342	+		9	Slipped, losing balance		+			+	+	0 Slight dorsal angulation	"Buckling," forearm probably doubled under
12	37175	+	+	7	Upon forearm	+	+	+	+	+	+	0 Slight ulnar angulation	Fractured twice before
13	35446	+		14	From horse	+	+						Five weeks old callus present
14	34613	+		15	From bicycle into ditch	+				+	+	Slight ulnar angulation	Treated by gypsum case in Texas

TABLE V—Continued
Group 3—Continued

Case	No of Case Record	Sex		Age	Nature of Fall	Right	Left	Greenstick		Complete		Displacement	Remarks
		M	F					Radius	Ulna	Radius	Ulna		
44	34925	+	+	8	Upon hyperextended hand		+++++	+	+	++	++	Dorsal of radius	"Special "
45	35168	+	+	17	Downstairs		+++++			++	++	Dorsal	"Special "
46	35101	+	+	12	From high jump, 3 feet		+++++		+	++	++	Dorsal	"Special "
47	38266	+	+	7	While running		+++++			++	++	Dorsal of radius	"Special "
48	36681	+	+	12	From skates		+++++			++	++	Dorsal	"Special "
49	37668	+	+	11	From cherry tree		+++++	+	+			Dorsal and mesial	"Special "
50	37822			9	From tree, 7 feet		+++++					Dorsal of radius	
	32	27	5			18	14	10	22	22	10	27	

Group 4 Fracture of Radius (Lower Third) and Ulna (Styloid Process) 6 Cases Velpeau Fracture

Case	No of Case Record	Sex		Age	Nature of Fall	Right	Left	Greenstick	Complete	Displacement	Remarks
		M	F								
51	34297	+	+	12	From skates	+	+	+	+	Dorsal	Abrasion of hand
52	PH1756	+	+	10	From swing	+	++	+	+	"Silver-fork "	
53	34768	+	+	14	From porch		++	+	+	"Bucking" dorsally	Note buckling from hyperflexion
54	41416			12	Downstairs upon hyperflexed hand		+	+	+	Dorsal "Bucking" dorsally	Cause probably hyperflexion
55	37285	+	+	11	?						
56	38555			9	?						
	6	3	3			2	4	3	3	5	

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Group 5. Fracture of Radius in Upper Third 3 Cases

Case	No of Case Record	Sex		Age	Nature of Fall	Site	Right		Left	Impacted	Complete	Remarks
		M	F									
57	41242		+	6	Down 5 steps	Neck of Radius			+	+		Occasional epiphysis for upper third olecranon present Head of radius slightly luxated anteriorly History incomplete
58	39320	+		11	Upon forearm	Neck of radius	+			+		
59	40520		+	11	?	Shaft	+					
	3	1	2				2		1	2		

Group 6 Fracture of Radius in Middle Third 3 Cases

Case	No of Case Record	Sex		Age	Nature of Fall	Direct Violence		Greenstick	Complete	Remarks
		M	F			Right	Left			
60	38682	+		15	From motor	+	+		+	Oblique, with loose fragment on side of concavity Incomplete mesially
61	35802	+	+	4	From cycle	++	++			
62	41164			12	Boy trod on			++		
	3	3				3	3	2	1	

TABLE V—Continued
Group 7 Fracture of Radius in Lower Third 16 Cases

Case	No of Case Record	Sex		Age	Nature of Fall	Right	Left	Greenstick	Complete	Colles's Displacement	Remarks
		M	F								
63	35872	+	+	6	Upon hyperextended hand		+++	++	+	0	
64	35015		+	5	From cherry tree		+++	++		0	
65	34612	+		10			+	+		Dorsal angulation	
66	35075	+		13	From slipping upon hyperextended hand		+	+	+	Volar angulation	
67	PH 1640	+	+	14	From cherry tree		+	+		Dorsal 0	"Buckling"
68	PH 1589	+	+	10	From bed	+			+	Dorsal	
69	37959	+	+	11	From fence, striking dorsum on stone		+	+		0	
70	37030	+	+	13	From skates	++		+	+	Dorsal	Impacted
71	38557	+	+	12	A boy forcibly hyperextended hand		++	++		Dorsal angulation	
72	41117	+		9	Upon hyperflexed hand					Dorsal angulation 0	
73	37918	+	+	17	Upon hyperflexed hand	+		+	+	Reverse volar	"Buckling" from hyperflexion
74	36864	+	+	14	?		+	+		+	Reverse of Colles's from hyperflexion
75	35967	+	+	11	From skates upon hyperextended hand			+		+ Dorsal angulation	
76	31113	+	+	17	From skates		+	+		+	
77	38642	+		15	Upon hyperextended hand	+		++	+	+ Dorsal angulation	
78	41157		+	6	From chair		++	++		+ Dorsal 0	"Buckling"
	16	14	2			5	11	11	5	11	

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Group 8 Strain, Sprain, and Disjunction of Epiphysis at Lower End of Radius

Case	No of Case Record	Sex		Age	Nature of Fall	Right	Left	Juxta-epiphyseal		Dorsal Displacement	Separation Tip of Ulnar Styloid	Remarks
		M	F					Strain	Sprain			
79	41246		+	13	From skates on hyperextended hand	++	+			+++		One month old, treated elsewhere for contusion History incomplete
80	37906	+	+	9	Upon hyperextended hand							
81	38115	+	+	14			?			+		
82	38604	+	+	14	?					++		Annular tenderness One year old, treated elsewhere for sprain, function impaired History incomplete History incomplete History incomplete Also, chip separated from radial border of metaphysis
83	40512	+	+	16	While running, upon hyperextended hand	+	+					
84	41116	+		11	Upon hyperextended hand							
85	40724	+	+	12	?	+	?			?		Treated elsewhere as sprain Annular tenderness
86	10171	+	+	10	?							
87	39687	+	+	14	From skates		+					
88	35194	+	+	13	From pole, 15 feet	+						Annular tenderness - Also, chip separated from radial border of metaphysis
89	36125	+		10	From trapeze		+			?		
90	35983	+	+	13	Down steps upon hyperflexed hand	+				+	+	
91	41521	+	+	12	From cherry tree upon hyperextended hand		+			?	+	
92	11103	+	+	19	Upon hyperextended hand	++	+		+	?		
93	40057	+	+	13	Upon hyperextended hand					o		
94	41122	+	+	9	From cherry tree, 15 feet		+			o		
	16	15	1			8	6	1	1	7	3	

TABLE V—Continued
Group 9 Fracture of Ulna in Upper Third 2 Cases

Case	No of Case Record	Sex		Age	Nature of Fall	Right	Left	Site	Greenstick	Complete	Remarks
		M	F								
95	34140	+		11	Upon hyperextended hand	+		Just below greater sigmoid cavity	+		Line runs from above and behind downward and forward
96	40876	+		12	Playmate fell on forearm	+		Shaft		+	
	2	2	0			2	0		1	1	

Group 10 Fracture of Ulna in Middle Third 4 Cases

Case	No of Case Record	Sex		Age	Nature of Fall	Right	Left	Displacement	Greenstick	Complete	Remarks
		M	F								
97	33000	+	+	4	From couch		+	0	+		16 days old, brought because of persistence of pain Diagnosed contusion elsewhere Direct violence preponderates in fractures of ulna No luxation of head of radius in this series
98	35153		+	7	From swing		++	++		++	
99	34054	+		14	Struck against log		++	++		+	
100	37920	+		9	From tree	+		+			
	4	2	2			1	3	3	1	3	

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radius and ulna peculiar to childhood and which constitutes about 13 per cent of fractures of the forearm. This fracture commonly occurs before the age of puberty, is most frequently encountered during the summer months, and is caused usually by the effects of gravity plus momentum. It is characterized by complete fracture of the radius with dorsal and lateral displacement of the lower fragment and by incomplete greenstick fracture of the inner half of the ulna, usually at a higher level, the outer half remaining intact and maintaining the deformity of the ulna, which is a bowing of the lower fragment toward the radial side and which, in turn, maintains the displacement of the distal fragment of the radius. In reducing this fracture the aim must be to convert the incomplete greenstick into a complete fracture by forcibly rupturing the still intact outer fibres, thereby enabling restoration of alignment of the distal fragment of the ulna with that of the axis of the bone, the distal fragment of the radius coincidentally shifting itself automatically into position. The criterion of reduction is the restoration of the normal alignment of the inner border of the ulna.

(2) Fracture of the lower third of both bones and of the radius alone comprise 70 per cent of fractures of the forearm in childhood. The site of the fracture and its variety may often be predicted by a knowledge of the history and mechanism of the fall.

(3) Injuries to epiphyses, whether strain, sprain, or disjunction, should be recognized and treated as fractures because of their importance in the growth of the bones and because epiphyseal injuries often predetermine infections, typically tuberculous.

(4) Diagnosis may be established clinically by the mechanism and "winching" tenderness. If deformity exist it is unjustifiable to elicit further signs of fracture. Skiagrams are of corroborative value, but by no means the final arbiters. Their chief value is in showing the degree of deformity and its presence after reduction.

(5) Owing to the delicacy of the radius and ulna in childhood fracture is the rule, while contusion and sprain are the exceptions.

(6) Treatment is begun by the administration of an anæsthetic if deformity exist. Otherwise a carefully prepared and padded splint (or splints) is applied firmly and without undue pressure. Skiagraphic control of reduction is important. Massage and passive motion are adapted to the individual case. The splints must be removed as soon as there is firm union.

(7) Operation is indicated only when conservative treatment is admittedly a failure. It will seldom be necessary. The inlay method of Albee should be used instead of an array of metal fixtures.

THE REFORMATION OF GALL-STONES AFTER OPERATION

By E MACD STANTON, M D

OF SCHENECTADY, N Y

NOTWITHSTANDING the relative frequency of clinical recurrences following gall-stone operations, actual reformation of stones in the gall-bladder or ducts following their removal by operative methods is of extremely rare occurrence. This is proven both by the observations of surgeons having a large experience in gall-stone surgery and by the remarkably small number of reported cases in the literature.

I believe, therefore, that the following case of definite reformation of stones in the gall-bladder after cholecystostomy is of sufficient interest to warrant reporting, together with a general summary of the available data concerning this phase of gall-stone surgery.

Mrs M G, age thirty-five, referred by Dr Geo P Harran, admitted to Ellis Hospital January 19, 1909, for an incomplete abortion. Soon after her admission to the hospital the foetus and placenta were passed without operative interference and from this trouble she made a prompt recovery. Several days later, however, she developed symptoms of subacute intestinal obstruction with pain referred to left lower quadrant. These attacks recurred on several occasions before her first operation.

First Operation (February 26, 1909) —Low median incision. Sigmoid adherent to region of Poupart's ligament by one firm band of adhesions which was apparently the cause of the obstructive symptoms. Right ovary slightly adherent. Appendix negative. Loosened adhesions. Excised right tube and appendix. Gall-bladder palpated and found full of large stones. High right rectus incision. Cholecystostomy. A number of large faceted stones removed and gall-bladder drained. Taite-Ochsner technic. Ducts free. No impacted stones. No noteworthy cholecystitis.

Two months after her first gall-stone operation she was able to return to work and for a period of five years she felt perfectly well and so reported on several occasions in answer to letters inquiring as to her post-operative condition. In April, 1914, she had her first recurrence of abdominal pain centred in the epigastrium and accompanied by much "pressure against her heart." The first attacks lasted from one-half to one hour with free intervals of about a week, but later the pains came on every few hours and the more severe attacks were accompanied by nausea and vomiting. During these attacks she again had considerable pain in the left lower quadrant.

Physical Examination —Well-developed, well-nourished woman. Chest negative. Nicely healed scars of old median and high right rectus abdominal incisions. Marked tenderness in right epigastrium and left

REFORMATION OF GALL-STONES

lower quadrant Marked tenderness in Boas' point posteriorly Also in left inguinal region Uterus pulled toward the left side with a tender mass in left fornix Right fornix free

Diagnosis—Gall-stones Left chronic salpingitis

Second Operation (June 3, 1914)—Ether-novocaine anæsthesia, low median incision, left tube and ovary found bound together in a mass surrounded by adherent sigmoid, two loops of small intestine adherent by stretched adhesions in region of old low median scar Omentum adherent to region of scar of old gall-bladder incision and around gall-bladder, which was felt to contain two medium-sized and a number of small stones Excised left tube and ovary High right rectus incision, loosened adherent omentum from gall-bladder and region of incision and excised gall-bladder, leaving clamp on stump of cystic duct Vioform gauze and rubber tissue drain placed around this clamp Ducts negative

Gross Pathology—Specimen consists of gall-bladder excised through the cystic duct together with a portion of the old abdominal scar which is adherent to the summit of the fundus of the gall-bladder The peritoneal surface of the gall-bladder is of a dull whitish color and roughened by a few fine tags of fibrous tissue On section the gall-bladder is found to contain thin golden-yellow bile and calculi of three distinct sizes, as follows two light yellow, mulberry type stones each measuring 1 cm in diameter, fifteen much smaller stones averaging only 2 mm in diameter, but each of a distinct mulberry type and of the same color as the larger stones, in addition, there are numerous soft yellowish concretions averaging only 1 to $\frac{1}{2}$ mm in diameter The mucosa is red to reddish-yellow in color with marked prominence of the papillæ

Microscopic Pathology—Numerous minute epithelial defects over summits of papillæ All sections show more or less subepithelial leucocytic infiltration while some sections show a well-marked lymphocytic and polymorphonuclear infiltration of all coats

Diagnosis—Recurrent cholelithiasis, cholecystitis, chronic left salpingitis, intestinal adhesions

Uneventful post-operative recovery

TRUE AND FALSE RECURRENCE—In considering cases of possible recurrence it is necessary to differentiate between the rare cases of true recurrences and the relatively frequent clinical recurrences due to stones overlooked at the first operation That the latter accident is of frequent occurrence, even in the practice of the most expert operators, is apparent from all statistics dealing with end results in gall-bladder surgery Thus Kehr¹ is aware of having, himself, overlooked stones in 25 per cent of 1105 cases operated upon between 1890 and 1909

McWilliams² found that stones had been overlooked seven times in 69 cases operated upon at the Presbyterian Hospital

Whittemore³ reports the finding of calculi in thirty secondary opera-

tions following 325 cholecystostomies for calculi performed at the Massachusetts General Hospital

My own studies⁴ of the causes for secondary operations on the biliary tract, covering a large number of cases compiled from the reports of numerous operators, would lead me to believe that stones are overlooked at the first operation in from 2 to 10, or even more, per cent of cases, depending upon the skill of the operator and the class of cases which he is called upon to treat

EXPERIENCE OF INDIVIDUAL SURGEONS—Maurice H Richardson,⁵ in a paper published shortly before his death, said, "Since my first operation on the gall-bladder, in 1886 or thereabouts, I have never seen, so far as I can recollect, a single case of recurring stones—of stones formed when once the gall-bladder had been thoroughly drained. It is unheard of in my experience to open a gall-bladder that has once been drained and to find gall-stones of recent formation, *ice*, gall-stones that are soft and bright colored. On the other hand, it is not at all uncommon for me to remove a stone overlooked at the original operation, especially when that operation was performed by a man of small experience."

Kehr,⁶ writing in 1911, says that in an experience of 1780 gall-stone operations he has seen only three cases of true recurrence of gall-stones, two after "*zystendysen*" and one after cystostomy, while after cystectomy and hepaticus drainage he had never seen a single case.

In tracing the end results⁷ in 245 gall-stone cases operated on to 1911, I found only three patients with a history suggesting reformation of stones, but in no instance had the suspicion been verified by a second operation.

TRUE RECURRENCES—The reported cases of true recurrence may be conveniently classified under the following heads: first, reformation of stones in the gall-bladder following cholecystostomy; second, reformation of stones in the ducts; third, cases in which the new stones have formed upon unabsorbable suture material or threads from gauze tampons used during the first operation; fourth, miscellaneous and doubtful cases.

Reformation of Stones in Gall-Bladder—CASE I (KORTE⁸)—Operation February, 1898, for perforating empyæma of gall-bladder. Two large stones removed and gall-bladder drained. Recurrence of symptoms a year later. Carlsbad treatment with no result. Reoperated four years after first operation and 1121 small stones removed. Recovery after cystostomy and hepaticus drainage.

CASE II (McWILLIAMS⁹)—Woman, age fifty-six, operated on March, 1896

REFORMATION OF GALL-STONES

Appendectomy and cholecystotomy Gall-bladder shrunken and atrophied and contained four stones Re-admitted in November, 1899, three years and eight months after operation, saying that she had been perfectly well until three months before, when she began to have severe attacks of colic in right epigastrium Vomited several times and frequently jaundiced Second operation Gall-bladder shrunken and buried in adhesions Numerous calculi found in gall-bladder Cholecystostomy Result six years after operation Has never had pain in gall-bladder region since This patient was perfectly well for three years and eight months after the first operation when she developed severe symptoms of calculi which were found to be very numerous at the second operation

CASE III (WESTBROOK¹⁰)—Woman, age thirty-five, operated upon May, 1906 Acute cholecystitis Cholecystostomy Six faceted stones about $\frac{1}{2}$ in in diameter removed Recurrence of pains one year later Operated on two years after first operation Cholecystectomy Thickened gall-bladder contained eight faceted stones, each of uniform size and color, about the diameter of large peas When last heard from, two years after the second operation, patient was well

CASE IV (STANTON)—*Vide infra*

New Stone Formation Occurring in Ducts—CASE I (KORTE¹¹)—Cholecotomy, May 12, 1898, with removal of stones from the common and hepatic ducts Healed June 15 Complete relief until December, 1899, when there was recurrence of colic with icterus Reopened February, 1902 Gall-bladder free Stones again found in choleductus and removed by choledotomy In this case Korte explored the hepatic duct to the bifurcation with his finger at the first operation, but the prompt recurrence suggests the probability that stones were overlooked above the bifurcation It is interesting to note that in this case there was no recurrence of stones in the gall-bladder

CASE II (KORTE¹²)—Operation, August 22, 1901 Cystostomy Turbid bile and many stones October 15, 1901, cystectomy Gall-bladder empty Small soft concretions removed from cysticus, choledochus and hepaticus Hepaticus drainage Hemp-seed sized calculi drained through the tube Hepaticus irrigations Carlsbad water and salicylates given Tube removed in six weeks with prompt closure of fistulae Soon had recurrence of chills and other symptoms Again operated on February 24, 1903 Turbid bile with purulent particles found in ducts and a bean-sized soft calculus was removed from the retro-duodenal portion of the common duct

Death March 11, 1903 Autopsy showed small soft concretions in the intrahepatic ducts similar to those previously found in the drainage

This cannot be considered a case of true recurrence

CASE III (KORTE¹³)—Operated on August 13, 1895 Cystostomy Seven hazel-nut sized stones removed from the gall-bladder and a similar stone from the cystic duct Also a walnut-sized stone from the dilated common duct. Prompt healing Seven years without noteworthy symptoms Reoperated upon December 12, 1902, with icterus, general cachexia ascitis and œdema Death March 6, 1903 Autopsy Carcinoma of stomach, peritoneum mesentery and regional lymphatics In the choleductus was a walnut-sized stone The ducts were greatly dilated but there were no other stones

The carcinoma with resulting partial obstruction to the bile flow will account for the reformation of stone in this case

CASES IV, V and VI—W J and C H Mayo¹⁴ mention three cases of recur-

rence of stones in the common duct after removal as follows "Stones may reform in the common duct after removal We have had this happen three times after a cholecystectomy had taken away the possibility of the usual site of formation We have never known recurrence of stones in the common duct after cholecystectomy, except under one or more of the following conditions the stones removed had originated in the gall-bladder, they had left as a legacy, an infected and thickened common duct, they had given rise to chronic pancreatitis, which in turn interfered with efficient biliary drainage"

CASLS VII and VIII—FLORCKEN¹⁵ quotes Korte as having found two additional cases of common duct recurrence following cholecystectomy and choledochotomy

New-Formed Stones with Foreign-Body Nuclei Suture Recurrences—
CASE I (KEHR¹⁰)—Woman, age fifty-four Cholecystostomy, February 23, 1893 Removal of an oval, flat, very hard stone the size of a large bean After a quarter of a year new attacks of colic that returned every three months August, 1895, icterus, gall-bladder very large A stone was passed by rectum and showed in its centre a silk thread

September, 1895 Cystostomy Many soft stones of which each enclosed a silk thread

October, 1895—Choledochotomy Several remains of stones, residue of first operation, removed

CASE II (KEHR¹⁷)—Woman, age forty-eight, operated on in 1892 Cholecystostomy for cholelithiasis After four years again had colics at intervals of three months for three years From 1899 to 1903 no symptoms

December, 1903 New attack Gall-bladder opened through a little cut in the old scar, there was much thick gall released, no stone found, drainage of gall-bladder On cleaning out with a piece of gauze a club-shaped stone was withdrawn and after that, with tweezers, a larger one The stone was 1 cm long, $\frac{1}{2}$ cm thick with club-shaped swelling at the end, enclosed in the centre a silk thread from the operation twelve years before Color of stone brown

CASE III (HOMANS¹⁸)—Woman, age thirty-eight, operated upon April 6, 1895 Cystostomy Healed in five weeks Trouble again showed itself in December, 1896 At a second operation, January 18, 1897, seven stones were found in bladder Three of these, the size and shape of a bean, lay along a silk thread which ran along in the axis of the three stones Two others were also bound together by a silk thread The last two small ones were free The threads arose from the sutures of the gall-bladder to the abdominal wall

CASE IV (ENDERLEN, reported by Florcken¹⁹)—Thread remains after cholecystostomy About five years previous had been operated on by Courvoisier Recurrence of colics and again operated Button-like stones were found running along a thread in the gall-bladder, also some free stones

CASE V (KEHR²⁰)—Formation on thread of gauze after cholecystectomy with tamponing of hepatic duct on account of tearing Woman, age forty-one Operated on February 5, 1900 Cholecystectomy Hepatic duct torn slightly and tamponed Later had attacks without icterus

October, 1900 Resistance in region of the scar Temperature, 38.8°, no icterus Diagnosis Overlooked stone in cystic duct (probably from the gall-bladder) Abscess on under side of liver, left over piece of gauze

Second operation October 23, 1900 By careful palpation of cystic duct

REFORMATION OF GALL-STONES

could be felt a round body, but which slipped under the fingers. Cystic duct opened and a sound passed liverwards and duodenalwards with no stones palpable. Increased the length of cut. The insertion of the little finger felt in the depths a soft stone which was extracted. Hepatic and cystic duct drainage. By closer examination of the stone it showed that it enclosed a piece of gauze. On breaking there were found two 3 cm long gauze fibres. The stone was very soft so that with the sound it could not be demonstrated. Following this concretion, which evidently lay in the cystic duct, were still others and, last, one of the size of a hazel-nut.

CASE VI (RITTER²¹)—Thread remains after gall-stone operation. A young woman for some months after the operation felt discomfort and at the end of the year, after a severe attack, a stone as large as a bean was passed. Through the middle of this concretion a short silk thread passed, which thread had been used as a ligature at the time of the first operation.

CASE VII (HANSEMAN²²)—The following case stands wholly isolated, inasmuch as it is not an example of stone formation in the gall-bladder or gall-passages but of gall-stone formation on a thread in the duodenum without recurrence in the gall tract itself.

Woman, age forty-eight. Operated on January 17, 1895. Gastrotomy, gastroenterostomy and partial resection of the bowel because of an advanced cancer of the pylorus. At autopsy, August, 1895, showed in the duodenum a silk thread on which were found two stones, the greater of which was about 12 mm long and 5 mm thick, the smaller 5 mm long and 3 mm thick. The stones were of gray-brown color, somewhat of the firm consistency of shell. Chemically they were formed from pigment and cholesterol, so they appeared to be real gall-stones, not fecal concretions. In the gall-bladder there were no stones.

CASE VIII (FLORCKEN²³)—Woman, age twenty-seven. Operated on October 30, 1903. Cholelithiasis with acute empyema of the gall-bladder. Many faceted stones removed. Cholecystostomy. Uneventful recovery. In January, 1906, again had gall-stone colic and passed two stones per stool. In January, 1908, again reported with gall-stone pains.

Second operation January 27, 1908. Distended, adherent gall-bladder containing two free stones (possibly overlooked at the first operation), also three stones fixed to the gall-bladder wall, each with a silk thread as its nucleus. One of these stones was ring-shaped, owing to the shape of the loop of silk composing its core.

CASE IX—DAVIS²⁴ reports a case not his at the primary operation but sent to him a year after her first operation complaining of even more severe symptoms than before her first operation. He found three chromic catgut sutures in her gall-bladder, they apparently having been used as purse-string sutures. Each one was studded with stones like beads.

Miscellaneous and Doubtful Cases—CASE I (KORTE²⁵)—Operated on August 24, 1891. Solitary stone in cystic duct, size of a pigeon's egg, oval, non-faceted. Gall-ducts themselves free. Cystotomy with iodoform gauze packing. Seven years later recurrence of colic with icterus. This patient did not return for observation and the sole evidence of a true recurrence is based on the long interval before the recurrence of symptoms.

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January, 1900 Passed two gall-stones without foreign body nuclei, after which there was no further trouble

The six-year free interval in this case is the sole proof of recurrence

CASE III (KORTE²⁷)—Operated upon April 28, 1893 Acute cholecystitis with threatened perforation Cystostomy 2550 small stones removed In 1904, eleven years after the first operation, had her first return of colic In November, 1904, Korte thought that he could feel a contracted stone-containing gall-bladder but the patient refused the proposed cholecystectomy

CASE IV—FLORCKEN²⁸ reports a case of gall-bladder regeneration with stone formation after cholecystectomy This case had had a cholecystotomy for empyema of the gall-bladder in September, 1908, followed by recurrence and cholecystectomy in December, 1908 Symptoms recurred again in six weeks and about twenty-five months later (February, 1911) a gall-bladder 3.5 cm long and 2.5 cm wide was found with a free cystic duct and containing a stone which Florcken took to be new formed The fact that symptoms recurred within six weeks after the first cholecystectomy makes it seem probable that this is really a case of overlooked stone in an incompletely resected gall-bladder instead of a true recurrence

CASE V (JAMES AND SHERMAN²⁹)—Female, age thirty-four A ten-year history of cholecystitis with acute exacerbations Operation December 30, 1910 Cholecystostomy No stones found in gall-bladder or ducts Ducts patent Fistulæ closed in 16 days Recurrence of pains 43 days after closure of fistulæ Spontaneous opening of fistulæ two days later with free drainage of non-icteric, mucopurulent fluid Continuous mucus discharge of from 25–200 cc of fluid daily until November 13, 1911, when she was reoperated Cholecystectomy A calculus 2 cm in diameter found impacted in cystic duct with complete occlusion of duct proximal to stone The stone was found to be a cholesterol calculus, bile free except for a pin-head sized, brownish nucleus The authors report this as an example of a stone forming in the gall-bladder or cystic duct after the first operation, yet if this stone was itself the cause of the blockage of the cystic duct, it must either have been overlooked at the time of the first operation or it must have formed within 43 days after the cessation of drainage On the other hand, if it was not the primary cause of the cystic duct obstruction it is hard to account for it having become impacted in the cystic duct during a period when there could have been no pressure behind it owing to the external fistula

CASES VI, VII and VIII—Three cases of late recurrence of clinical symptoms classified by me in a previous paper (*loc cit*) as probable instances of reformation of stones but as yet, as far as I know, none of these cases have undergone a second operation

SUMMARY AND CONCLUSIONS—If no foreign body is left in the gall-bladder or ducts after the operation, the reformation of gall-stones is so rarely observed as to constitute almost a negligible factor in gall-bladder surgery

The reported cases do not bear out the assumption that cholecystectomy affords a much greater immunity against reformation of calculi than does cholecystostomy

REFORMATION OF GALL-STONES

Adequate care should be exercised not to leave threads from gauze sponges nor unabsorbable suture material in the gall-bladder or ducts at the close of the operation

The data consulted during the preparation of this paper has further strengthened me in the belief that the two most important factors in determining the end results of gall-bladder surgery are the *complete* removal of the calculi and the maintaining of sufficiently prolonged post-operative drainage. In the absence of organic duct strictures I believe that the question of cholecystostomy *vs* cholecystectomy is largely one of technical expediency in individual cases. In many badly diseased gall-bladders it is easier and safer to remove the gall-bladder than to try to remove all of the stones and fragments of stones from the gall-bladder *in situ*, and the same is often true of gall-bladders containing great numbers of minute stones and cholesteroline particles

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DOUBLE INTERNAL JUGULAR VEIN—HIGH BIFURCATION OF COMMON CAROTID ARTERY

BY JOHN W. CHURCHMAN, M.D.

OF NEW HAVEN, CONN.

PROFESSOR OF SURGERY IN YALE UNIVERSITY

I HAVE recently met, during the dissection of the neck, two anatomical variations in the large vessels which seem to be of sufficient importance to record

Double Internal Jugular Vein—The first anomaly was encountered during the removal of tuberculous glands from the upper part of anterior cervical triangle on the right side. The operation was done through a transverse incision parallel to the lower jaw and about $1\frac{1}{2}$ inches below it. A large tuberculous gland, tightly adherent to the platysma muscle, was encountered and dissected free from this structure with some difficulty. The internal jugular vein was then exposed in its usual position (see Fig 1, B), and the gland found to be very closely adherent to it. It was gradually freed, however, without injury to the vein. A dissection of the lower portion of the gland was then begun and I was surprised to find at the site indicated in the drawing (see Fig 1, C) another vein, larger than the first, roughly parallel with it, and about 1 inch distant from it,¹ running behind the gland, to which it was adherent. This vein was freed from the gland without much difficulty, and the glands then removed in the usual way without incident. The first vein encountered ran in the usual situation, immediately adjacent to the carotid artery. Through the transverse incision used in this operation the origin and termination of the second vein could not be determined. Its position is well shown in the drawing (see Fig 1, C). It responded very markedly to the respiratory movements of the patient, and when ballooned by expiration was about one-third again as large as the vein first met.

This anomaly must be sufficiently rare, at least I have not encountered it in a large number of neck dissections. Some of the anatomical text-books make rather vague reference to the occasional occurrence of a double vein, and Columbus (1590), quoted in Theile's treatise on

¹ The artist has represented these two veins rather closer together than they actually were.

the muscles and blood-vessels, reports having seen this anomaly. The possibility of a second internal jugular vein is perhaps worth bearing in mind, particularly in adherent gland cases, for after the glands have been freed from the vein, one, proceeding rapidly and with the usual sense of relief, might injure a second vein if one were not prepared to meet it.

High Division of the Common Carotid Artery—The second anomaly, of much more frequent occurrence, I happen never to have observed before. In this patient a dissection of the glands in the upper part of the neck was being done as a preliminary to excision of the jaw for giant-celled sarcoma. After the glands had been removed, I proceeded to ligation of the external carotid artery. On exposing the usual point of division of the common carotid, no such division was found nor could any branch representing the external carotid be located by following the vessel down below the level of the lower border of the thyroid cartilage. On following the vessel up, however, the bifurcation was found under the posterior belly of the digastric muscle, but could only be seen on retracting this structure upward. There were no branches seen coming from the part of the common carotid exposed below the bifurcation. I did not make a note of the superior thyroid artery but my impression is that it arose from the external carotid just beyond the point of division. Of course, with the neck well exposed as in this particular operation, this anatomical variation was of very little importance, causing slight delay but no particular embarrassment. If, however, one had been attempting to ligate the external carotid through a small incision, one would have been considerably embarrassed by this unusually high point of division, which is well shown in the accompanying illustration (see Fig. 2).

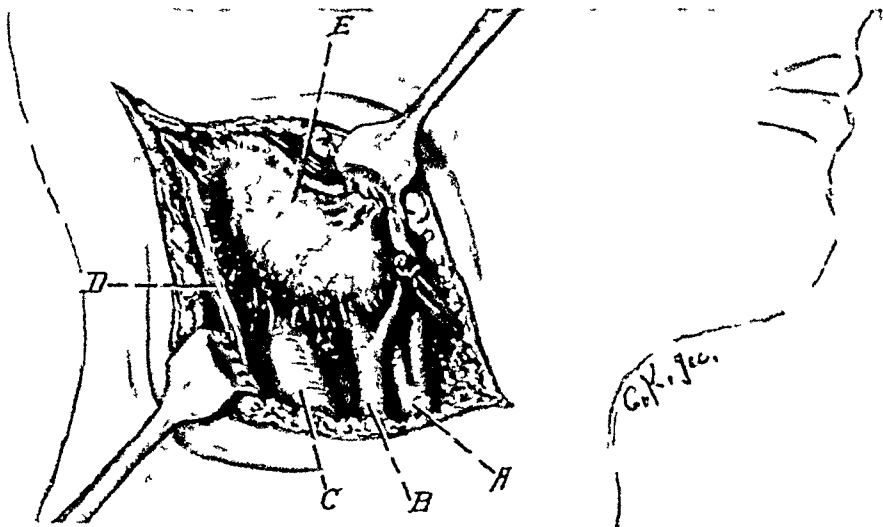


FIG 1 —Double internal jugular vein A, common carotid artery, B internal jugular vein, C, second internal jugular vein, D, retracted sternocleidomastoid, E, tuberculous gland

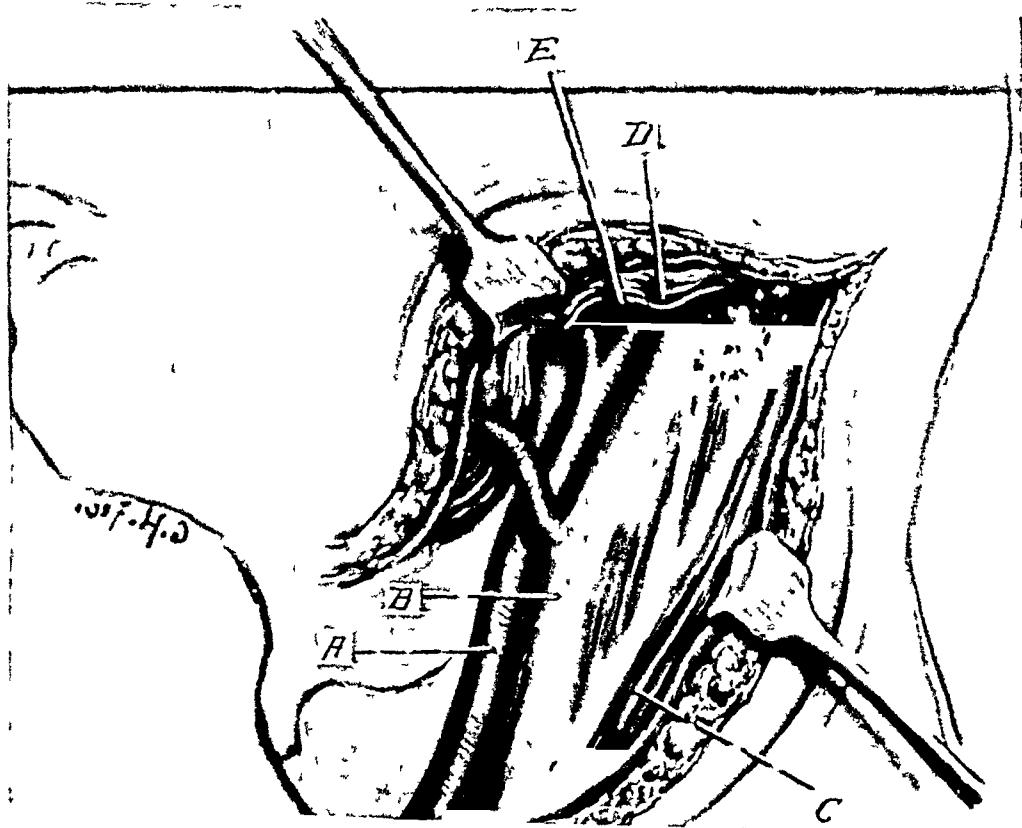


FIG 2 —High bifurcation of common carotid artery A common carotid artery, B internal jugular vein, C sternocleidomastoid retracted, D, digastric muscle, E, bifurcation of common carotid artery

TRANSACTIONS

OF THE

PHILADELPHIA ACADEMY OF SURGERY

Stated Meeting, Monday evening, October 5, 1914

The President, DR JOHN H GIBBON, in the Chair

MOWING MACHINE CUT OF LEGS

DR EDWARD B HODGE presented a boy of three and a half years whose right leg had been nearly severed by the blade of a mowing machine. Both bones and the anterior tibial vessels and nerve, with the extensor muscles, were entirely divided. There was some laceration of the calf muscles next to the bones, but the posterior tibial vessels were not injured. Circulation in the foot was good. Under iodine sterilization the anterior tibial vessels were tied, the nerve sutured, and the ends of the divided muscles united as accurately as possible without unduly enlarging the incision and prolonging the operation. The child had lost much blood. The wound was dressed in a fracture box without drainage. Healing took place with slight discharge of serum, but no infection, and the boy has a perfectly useful leg. There is slight toe-drop and later it is probable that some further work will be needed on the muscles. There is a slight amount of sensation on the dorsum of the foot.

SARCOMA OF TONSIL

DR GINSBURG presented a man who had developed a growth in the right tonsil, the condition dating back to April of the present year. He had operated upon it in two stages, in the first operation, he removed the anterior palatine arch and the tonsil. Three weeks later, he made a dissection of the neck, removing the right submaxillary salivary gland, and all visible lymphoid tissue, finally ligating the external carotid artery at the bifurcation of the common carotid. A rapid recurrence has followed, and at present he is receiving daily treatments with radium, holding the tube containing the radium in his mouth for five hours at each sitting. Thus far he has received six radium treatments, and there is evidence of beginning resolution of the pathological overgrowth. The diagnosis is sarcoma of the right tonsil.

PHILADELPHIA ACADEMY OF SURGERY

AN ANALYSIS OF TWO HUNDRED AND TWENTY-SIX CASES OF ACUTE INTESTINAL OBSTRUCTION

DR GEORGE G ROSS read a paper with the above title, for which see page 198

DR CHARLES H FRAZIER said that one of the most important life-saving factors in the management of cases of intestinal obstruction is the avoidance of a general anæsthetic, particularly ether. These patients are intensely toxic and do not stand an anæsthetic well. The greater part of the operation can almost always be conducted under a local anæsthetic, and at most a few whiffs of nitrous oxide may be required to allay pain.

DR JOHN H GIBBON said that there are two elements in the mortality of strangulated hernia or intestinal obstruction. One is the anæsthetic, already mentioned by the authors and in discussion. General anæsthesia should be avoided whenever possible, in the hernia cases especially. If a general anæsthetic is used, it should be as short a period of general anæsthesia as possible. Not only because of the bad effect of the anæsthetic upon the patient, but because the man who is operating under a general anæsthetic is tempted to do a great deal more than if operating with a local anæsthetic. It is trying to complete an operation that often results in the death of these patients. This is particularly true in regard to colonic obstruction. When the patient is anæsthetized it is easy to make the mistake of trying to do too much instead of simply trying to relieve the obstruction, and doing the radical operation at a later stage.

Another point is that of post-operative obstruction—a condition the frequency of which has greatly diminished in recent years. This difference is due to the fact that we are not packing abdomens full of gauze, and that drains are covered with rubber to prevent adhesions.

DR ROSS, in closing, said that the technic carried out is a very simple one. As a rule, a general anæsthetic is used, infrequently, a local anæsthetic. The anæsthetic is given to the degree that obstetricians give it, enough to dull the patient's sensibilities. The abdomen is rapidly opened with a liberal incision and evisceration done at once. No attempt is made to locate the obstruction. The entire small bowel is delivered and laid upon a wet towel. At once the obstruction comes into view and it is dealt with according to the condition of the bowel and condition of the patient. If the patient is profoundly toxic, enterostomy is done and the wound sewed up. If the patient's condition warrants it, resection is attempted when the bowel is badly damaged, but as a rule the intestines are put back at once, salt solution used, drainage instituted.

TRAUMATIC RUPTURE OF THE DEEP URETHRA

and the wound sewed up Paul's tubes we rarely use to drain the bowel Occasionally, but rarely, the bowel is fastened to the anterior abdominal wall for the purpose of permanent drainage.

Post-operative adhesions are diminishing in frequency It used to be, five, six or seven years ago, that one patient out of eleven coming to the German Hospital with appendiceal abscess and drained with the method employed at that time, of large folds of iodoform gauze, had post-operative obstruction This is not so to-day, because a different method is used Rubber tissue is used to protect the capillary drains and prevents adhesions

TRAUMATIC RUPTURE OF THE DEEP URETHRA

DR GEORGE G ROSS presented a boy, aged eleven, who was run over by a heavy wagon, the wheels passing diagonally over the right lower abdomen, pelvis and left hip, at 7 30 P M , April 21, 1914

On admission the boy was shocked and in great pain, temperature remained subnormal until the following morning Pulse was weak and thready and rose to 144 by the following noon Examination revealed a bruised abdomen and hip, and in addition a fracture of the left tibia in the upper third. The patient's chief complaint was rectal pain No urine was voided from 7 30 P M until the following day. Shortly before noon the day after the accident the patient was catheterized Before this had been done some blood was noted at the meatus The first use of the catheter brought a few drops of blood and later one-half ounce of bloody urine There was great abdominal and perineal tenderness and swelling in the perineum At 2 15 P M , on April 22, hypodermoclysis was given and strychnine ordered Dr Ross saw the patient at 4 P M. and concluded that operation was inadvisable because of the patient's general condition

In the next few days the abdominal rigidity lessened and catheterization was possible A retention catheter could not be employed because of the discomfort caused The patient's general condition improved, the pulse, however, remaining very weak and there being always much abdominal pain and tenderness An X-ray showed a fracture of the descending ramus of the left pubic bone The patient began to void urine fairly well four or five days after the accident, often involuntarily, and had involuntary bowel movements

On April 27, the sixth day, he became very restless and began to run a septic temperature Examination revealed a lower abdominal resistance with tenderness suggesting urinary extravasation, and operation was decided upon On April 28, 1914, one week after the accident, a

suprapubic incision was made and the space of Retzius opened. A large quantity of ammoniacal urine was evacuated. The broken portion of the pubis could be easily felt, but evidently had sprung back partly into place. A catheter (silver) introduced showed its tip through a rent in the bladder just at the site of the urethral junction—or the site of the urethral avulsion—and could not be introduced into the bladder proper. Drainage tubes were introduced and allowed to remain a number of days. The temperature was septic for a week, and mildly febrile for a week, and then from the third to sixth week septic, but not severely so. All urine came through the suprapubic wound. Several attempts at catheterization were failures. On May 27 a deep gluteal abscess was opened by his assistant, Dr Mencke. It was a hard abscess with little pus that had been extremely painful and evidently caused by deeply burrowing urine. The suprapubic wound showed great tendency to close and the discharge of urine was impeded. This gave the patient great pain. The incision was again enlarged on May 27, but an attempt to pass the catheter was unsuccessful.

Finally, these closures exhausted the patient so much that on June 9 under ether anæsthesia he attempted catheterization, and was successful in introducing first a silver catheter and then a 10 English woven catheter, which was sewn in and remained five days. The suprapubic incision was cleaned of old granulations. The former bladder rent was not felt. The catheter remained in five days and since then the patient voids naturally. No urine has come out above since the last operation.

DR GWILYM G DAVIS said that, in cases of rupture of the urethra in the membranous portion or in close connection with the bladder, difficulty is often experienced, as in this case, of passing the catheter into the bladder. Some years ago he was visiting in the country and he was asked to see a man who had sustained a rupture of the urethra from falling astride a board. There was no external wound at all, and the endeavor to introduce a catheter by the usual method was a failure. He therefore injected warm water into the urethra through the meatus, which distended the urethra and also the parts at the site of the injury. He then took up a large metallic catheter and with ease passed it across the broken part into the bladder. He suggested the method as worthy of trial in such cases.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY

*Stated Meeting, held at the New York Academy of Medicine, November
11, 1914*

The President, DR. FREDERIC KAMMERER, in the Chair

ECHINOCOCCUS CYST OF THE LIVER

DR. A. V. MOSCHCOWITZ presented a married woman, forty years old, of Russian birth, who on March 19, 1914, was admitted to the medical service of the Har Moriah Hospital, in the care of Dr. S. Neuhof.

Her chief symptoms were entirely referable to the urinary system, namely, pain in the region of the right kidney and anuria of four days' duration, followed by frequent but scanty urination.

In the region of the right kidney palpation definitely located a globular mass the size of a large coconut, this was painful and tender on pressure and moved slightly with respiration. The quantity of urine voided on different days varied from 880 to 1360 c c, its specific gravity ranged from 1010 to 1015, it was negative for albumin, sugar, bile, casts and cells, there was an ample excretion of urea.

The patient was operated on for a supposed hydronephrosis, on April 6, 1914. Through an incision parallel to the last rib a normal kidney was exposed, and the large mass, it was then made out, was located within the peritoneum and connected with the liver. The peritoneum was thereupon incised, and, no adhesions being present, a small portion of the tumor was isolated by packing, and upon aspiration a perfectly clear, limpid fluid was obtained. The fluid was under such tension that immediately upon withdrawal of the fine needle, echinococcus daughter cysts popped out. The capsule was thereupon incised and its contents evacuated, and as the condition of the patient warranted it, the mother cyst was enucleated from the parenchyma of the liver. The hemorrhage, which was rather profuse, was readily controlled by packing, and in order to secure a firm basis for the packing the liver was fixed in the wound by sutures.

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impacted low down in the ileum. The intestine was firmly contracted upon the stone, so that no amount of warranted manipulation could dislodge it upward into the dilated portion of the intestine. He was therefore compelled to cut down upon the stone at the contracted part. Upon removal it was found to have one large facet, but it was uncertain whether this facet was directed upward or downward. The intestinal incision was closed in two layers, but this narrowed the lumen to such an extent that it was deemed advisable to add an entero-enterostomy between the proximal and distal loops. A hasty palpation of the gall-bladder and the rest of the intestines failed to reveal the presence of the expected companion stone.

During the various manipulations there were noted literally hundreds of indurated areas, covered with fibrin, in the mesentery, near its attachment to the small intestine. The larger ones were fully the size of a marrow-fat pea; these were wiped out with tincture of iodine, and a culture subsequently showed the bacillus coli communis to be the infecting agent. The speaker said he accounted for these small abscesses by assuming traumata and ulcerations of the intestinal mucosa caused by the migration of the stone, with subsequent infection and transmigration of the bacillus coli into the mesentery.

The closure of the wound proved difficult and incomplete, and it was drained by a tube and rubber dam. The prognosis was apparently very bad and Dr. Moschowitz said he was agreeably surprised when he found a few hours later that the patient had reacted well from the operation and was in a fair condition. On account of the presence of the numerous abscesses in the mesentery which had been practically left untreated, he still regarded the outcome of the case as unfavorable. For some time after the operation the wound discharged very freely, the pus having an offensive odor. On June 5 the patient complained of pain in the rectum, and examination revealed the presence of the long searched for companion stone. The discharge from the wound gradually diminished and the patient was discharged, well, on June 13.

DR. WILLIAM A. DOWNES recalled a case of gall-stone ileus about three years ago, shown by him before this Society, which came under his care at St. Francis Hospital, in the service of Dr. Kammerer. In that case, about forty-eight hours after the original operation, at which one gall-stone was found and removed, the symptoms of intestinal obstruction recurred, and upon reopening the wound, a second stone was found impacted in the gut at the point where the sutures had been in-

Tube and gauze drainage was inserted and the external incision partially closed

Subsequent to the operation, the wound in the liver discharged bile rather freely. The tubes and packing were gradually shortened and the wound finally closed, the patient being discharged in a little over five weeks. At no time was there any anaphylactic reaction.

Dr Moschcowitz said he had no apologies to offer for the erroneous diagnosis in this case, he was led into it by the history, the symptoms and physical signs, all of which pointed to an involvement of the kidney, and by the absence of all those physical and clinical signs that one would be led to expect to find in echinococcus disease of the liver.

DR JAMES I RUSSELL recalled a case of echinococcus cyst of the liver in which the symptoms, with the exception of a slightly higher eosinophilia, were practically identical to those in the case shown by Dr Moschcowitz and led to a similar error in diagnosis. The symptoms, as in this case, were ascribed to a probable hypernephroma, and after exposing a normal kidney the tumor was found underneath the peritoneum and proved to be a pedunculated echinococcus cyst of the liver which was extirpated *in toto*.

GALL-STONE ILEUS

DR MOSCHCOWITZ presented a married woman, fifty-eight years old, who was successfully operated on by him on May 18, 1913, for a large, irreducible umbilical hernia by the Blake method. She was readmitted to the Mt Sinai Hospital on May 11, 1914, when the following history was obtained. There had existed an absolute constipation for the past four days, accompanied by increasing abdominal distention and incessant vomiting, which had become fecal in character during the past twelve hours. The patient was markedly prostrated, with a rapid pulse, but no fever. The entire abdomen was enormously distended and very painful and tender, but there was nothing localizable and no recurrence of the hernia. The diagnosis of intestinal obstruction of unknown origin was made. Gall-stone ileus appeared to be the least likely, as there was nothing in the history that was referable even remotely to the liver or bile tract.

An immediate operation was done. The old cicatrix was first excised and no recurrence found. Numerous distended loops of small intestine were encountered, and the entire colon was collapsed. Palpation revealed, as a cause of the obstruction, a stone, the size of a walnut,

impacted low down in the ileum. The intestine was firmly contracted upon the stone, so that no amount of warranted manipulation could dislodge it upward into the dilated portion of the intestine. He was therefore compelled to cut down upon the stone at the contracted part. Upon removal it was found to have one large facet, but it was uncertain whether this facet was directed upward or downward. The intestinal incision was closed in two layers, but this narrowed the lumen to such an extent that it was deemed advisable to add an entero-enterostomy between the proximal and distal loops. A hasty palpation of the gall-bladder and the rest of the intestines failed to reveal the presence of the expected companion stone.

During the various manipulations there were noted literally hundreds of indurated areas, covered with fibrin, in the mesentery, near its attachment to the small intestine. The larger ones were fully the size of a marrow-fat pea. These were wiped out with tincture of iodine, and a culture subsequently showed the bacillus coli communis to be the infecting agent. The speaker said he accounted for these small abscesses by assuming traumata and ulcerations of the intestinal mucosa caused by the migration of the stone, with subsequent infection and transmigration of the bacillus coli into the mesentery.

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sented Such cases, Dr Downes said, if the patient's condition would permit, showed the wisdom of making a thorough search when we were dealing with a faceted stone

SPASTIC PARAPLEGIA DUE TO ABNORMALITY OF THE POSTERIOR SPINAL VESSELS

DR CHARLES A ELSBERG presented a Turk, twenty-three years old, who was admitted to the Neurological Service of Mount Sinai Hospital on the service of Dr B Sachs, in October, 1914 The patient complained of cramp-like pains in the right side of the abdomen, running down the right lower extremity, of three months' duration With this there had occurred symptoms of increasing loss of power and spasticity in the lower extremities

Physical examination showed that the abnormal reflexes were absent on the right side The knee-jerks were exaggerated, the left greater than the right There was no clonus nor Babinski The left leg was weaker than the right There was a slight tenderness of the spinous processes of the ninth dorsal segment The Wassermann test and X-ray were negative The symptoms gradually grew worse, so that one week later he had slight Babinski on the left side, with exhaustible ankle clonus and spasticity of the left lower extremity The sensory signs consisted of almost complete loss of pain, temperature and touch of the right lower extremity up to the level of the tenth dorsal segment The symptoms therefore pointed to a focal lesion, surely extramedullary, probably in the anterolateral region at the ninth to the tenth dorsal segments

Laminectomy was performed by Dr Elsberg on October 16, 1914 The spinous processes and laminae of the seventh, eighth and ninth dorsal vertebrae were removed in the usual manner When the dura was opened there was an escape of a large amount of cerebrospinal fluid The surfaces of the cord were found normal The fifth and sixth dorsal spines and laminae were then removed, and the dura incised in an upward direction It was then seen that the right posterior spinal vein ran a normal course, while the left was much enlarged, and ran, together with the sixth left posterior root, through the opening in the dura The vein was almost again as large as the nerve root The vessel was tied off at the dural opening and about two centimetres of it excised The wound was closed in the usual manner

Convalescence from the operation was uncomplicated The patient was out of bed in two and a half weeks, the symptoms improved rapidly,

EXTRAMEDULLARY SPINAL TUMOR

and by November 2, all of the sensory and most of the motor symptoms had disappeared. He was free from pain and seemed to be cured.

Dr. Elsberg mentioned that this was the second instance of an abnormality of the posterior spinal vessels of this kind that he had operated upon. The first patient presented very similar symptoms and was completely and permanently relieved by the excision of the enlarged and abnormally located blood-vessel. This was a condition which had not been described in the literature, *i e*, that an abnormal vessel could cause a spastic paraplegia with level symptoms, and that complete relief could be gained by operation.

These two cases, Dr. Elsberg said, would be reported in detail in another place.

EXTRAMEDULLARY SPINAL TUMOR

DR. ELSBERG presented a man, twenty-four years old, who was admitted to the New York Neurological Institute in January, 1912, with a history of one year's standing. He first noticed a tickling sensation in the calf of the right leg, gradually extending upward. This persisted for ten months, when he noticed that when taking a bath the upper part of his body was more sensitive than the lower. Nine months before, the right knee became stiff and he had difficulty in walking. Four months ago the left leg became similarly affected, and since that time he had grown gradually worse.

At the time of his admission there was a marked spastic paraplegia of the lower extremities, with sensory symptoms of all three sensations to the left of the tenth dorsal segment. The Wassermann and X-ray were negative. Patient refused operation and left the hospital. He returned on the first of July in a much worse condition. He was bed-ridden, and there was complete paralysis of the lower extremities, with marked bladder and rectal disturbance.

The physical examination showed spastic paraplegia of both lower extremities, with exaggerated reflexes, ankle clonus, Babinski and Oppenheim. The sensory symptoms consisted of diminution of all three sensations up to the tenth dorsal level on the right side, and a total loss of feeling to the same level on the left.

Laminectomy was performed on July 5, 1912, the spines and laminae of the five lower dorsal vertebrae being removed. Nothing was found to explain the symptoms. The patient went home after two weeks, unrelieved.

He was next seen at Montefiore Home in January, 1914. At this

time there were symptoms, both sensory and motor, up to the level of the second dorsal segment with no sensory disturbances in the upper extremities, therefore, this part of the cord was exposed by laminectomy on January 6, the seventh and eighth cervical and first and second dorsal spines being removed. Nothing was found over the region of the exposed spinal cord. A probe passed upward, however, met with a resistance at the level of the sixth cervical; therefore three more spines and laminae were removed in an upward direction, and at the upper area of cord exposed, far above where the symptoms had indicated, a small extramedullary tumor was found and easily removed.

Convalescence from the operation was uncomplicated. Improvement began at once, and at the present time the patient was practically entirely well, he was able to walk long distances without trouble, and all of the motor and sensory symptoms had disappeared.

The interest in this case lay in the shifting of the level symptoms. In July, 1912, the symptoms pointed clearly to the tenth dorsal segment, in January, 1914, the symptoms pointed to the second dorsal segment, but the tumor was found at the sixth cervical segment.

APERIOSTEAL AMPUTATION THROUGH THE FEMUR

DR H H M LYLE presented a young man who, while speeding on a motor cycle, collided with an automobile. He sustained a severe, compound, comminuted fracture of the ankle-joint, with extensive laceration of the soft parts. On arrival at St. Luke's Hospital on August 29, 1914, the wound was immediately explored, the ground-in dirty straw and clothing removed, drainage provided, and a prophylactic dose of tetanus antitoxin administered. On the following day his temperature rose to 106° , and the wound showed unmistakable evidence of gas bacillus infection. The rapid spread of the emphysematous gangrene necessitated the removal of the leg at the knee-joint, a Stephen Smith disarticulation being done.

Although the procedure served to check the spread of the gangrene, the wound broke down and the flaps retracted to such an extent that an aperiosteal amputation through the junction of the lower and middle thirds of the femur was done by Dr. Frank S. Mathews. As soon as the wound healed, Hirsch's medico-mechanical exercises were begun, and fourteen days later the patient could bear all his weight directly on the end of the stump, and at present he could walk comfortably on the home-made peg-leg (Figs 1-4).

Dr. Lyle said his object in presenting this case was to emphasize the



FIG 1—Patient bracing his weight on the stump 14 days after the healing of the wound



FIG 2—Patient exercising with peg-leg



FIG 3—Patient exercising with peg-leg



FIG 4—Patient wearing a home-made peg-leg. P was able to walk on this leg 14 days after the healing of the wound

value of the systematic post-operative treatment of the stump, and to prove that it was possible in amputations through the shaft of the femur to produce a painless end-bearing stump. He conceded that the osteoplastic method was the ideal one under ideal conditions, while the tendinoplastic was of limited value. The periosteal, although employed by the majority of the surgeons in this country, was inferior to the other methods, while the aperiosteal, in the advent of complications in healing, was the only method which was likely to furnish a useful end-bearing stump. It was the simplest, the most universally applicable and the most practicable.

In reply to an inquiry as to the technic employed, Dr. Lyle said he removed the periosteum for a distance of one centimetre above the saw-line, and spooned out the medullary canal for a similar distance. The stump was treated as follows. As soon as the wound had healed, the stump was massaged twice daily and after each treatment a two per cent solution of salicylic acid in olive oil was rubbed in. At night the parts were bathed in a warm sodium carbonate solution and the stump protected with lamb's wool. A box was placed at the foot of the bed and the patient instructed to press the stump against it for from five to ten minutes, at first three times a day, then four times, and finally every hour, and after each treatment the hip was energetically flexed and extended. After this the standing exercises were begun, the patient resting the stump on a bran bag, at first placing the weight evenly on both legs and later resting all his weight on the stump. At the end of two weeks the patient should be able to wear a peg-leg and later a permanent prosthetic appliance which directly receives the weight through the end of the stump.

DR. ROBERT H. M. DAWBARN said that when we resorted to a Stephen Smith disarticulation in a case where there was ulceration at any point on the limb below the flaps, we were practically certain that suppuration would follow. In such cases he removed the patella as a matter of course, because even though its lateral attachments were well divided, it so pressed down upon a drainage tube passing beneath, up into the synovial sac above, as to interfere with drainage and seriously prolong a suppurative case.

Speaking of amputations through the thigh, Dr. Dawbarn said he wished to congratulate Dr. Lyle and Dr. Mathews upon the very satisfactory outcome of this case. At the same time, it violated the dictum of Bier that in order to make a comfortable, end-bearing stump, we must have articular cartilage or undisturbed periosteum. If we get

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aseptic healing, we can sometimes expect a comfortable, end-bearing stump just the same, without these coverings to the bone

In order to avoid the contraction of certain muscles of the thigh that follows the division of all at the same level, and thus to prevent objectionable "dead spaces," the speaker said the hamstring tendons should be divided as a preliminary measure. This would permit the muscles that extended from the pelvis to the leg, gliding over the femur in their course without attachment to it save part of one hamstring, to retract, and they would then, upon amputation, all have about the same level as that of the remaining muscles of the thigh which could not retract far when cut because of their long attachment to the femur. This point in technic was performed even before cording the thigh by two bold strokes, each of which divided the hamstring or hamstrings of its own side, an assistant at once thrusting his thumb into the wound, thus preventing bleeding. Then the cording was done and amputation followed.

Hamstring against dead spaces was credited to Dr. Dawbarn, he added, in the works on surgery of Fowler, Brewer and others, and should be better known than it is.

DR. LYLE, in closing, said the original dictum of Bier which was referred to by Dr. Dawbarn was no longer adhered to by Bier himself. While the Bier method was the ideal one, the aperiosteal was preferable in those cases where suppuration had occurred and the former could not be used.

As to the length of time of after-treatment required by this method, the speaker said that depended on the length of time the wound took to heal. After the patient could once walk on the stump, the exercises could be abandoned.

PRESERVATION OF THE ILIOHYPOGASTRIC NERVE IN OPERATION FOR THE CURE OF INGUINAL HERNIA

DR. CHARLES N. DOWD read a paper with this title, for which see page 204.

DR. ALFRED S. TAYLOR said that instead of being cut, this nerve was occasionally caught in the sutures and gave rise to trouble in that way. He recalled such a case which was operated on by Dr. Robert F. Weir. The patient complained of considerable pain and tenderness about the wound, and when the latter was opened, a deep infection being suspected, they found instead that the iliohypogastric nerve had been caught.

in one of the sutures, which by compression had given rise to a neuritis. Since his observation of that case, Dr Taylor said, it had always been his practice to elevate the nerve and in that way avoid its inclusion in the suture.

DR ARTHUR S VOSBURGH said that in order to interfere with the innervation of these muscles, the cutting of the nerves had to be done at a point above the internal ring, where they gave up their motor filaments to these muscles, as the parts of the nerves that appeared in the field of operation were purely sensory and were distributed to the skin and subcutaneous tissues. A neuritis or neuralgia might easily be set up by pinching the nerve in one of the sutures if too tightly drawn, as suggested by Dr Taylor.

In connection with recurrent hernia, as mentioned by Dr Dowd, the great majority were found to be direct. This preponderance of direct hernia in the recurrences Dr Vosburgh thought could be explained by the fact that many small direct or potential herniæ were not recognized at the time of the first operation. The oblique hernia would be cured, but the beginning direct hernia would manifest itself as a recurrence. A direct hernia occurring through the outer portion of Hesselbach's triangle would simulate closely an oblique inguinal hernia. If the Bassini method was followed in such a case, the result was almost sure to be a recurrence. Personally, it was his practice to see that the neck of the sac was external to the deep epigastric artery, and only in those cases was the Bassini method followed. In direct hernia he invariably did a transplantation of the rectus. He recalled a case of direct hernia where the musculature seemed so good that he was led to try the Bassini method. The operation was followed by a prompt recurrence, and when the patient returned to him, he did a transplantation of the rectus, and the man had up until the present time remained free from a further recurrence.

Dr Vosburgh said that in recent years he had observed a great many more cases of direct hernia than in the past. Whether this was merely a coincidence or whether he had become more successful in recognizing the condition he was unable to say. At all events, he was convinced that a direct hernia should always be treated by a method other than the Bassini.

DR FRANK S MATHEWS said that in two or three cases coming under his observation where an appendix operation was done through a fairly low incision, the operation was followed by an ordinary right inguinal hernia. He had had reason to think that the herniæ were due

to nerve injury, as the incisions had not been low enough to divide the muscle fibres supporting the ring

DR DAWBARN said he thought there was no doubt about the accuracy of the observation made by Dr Mathews. If we did the muscle-splitting operation for the removal of the appendix, we were much less likely to divide the iliohypogastric or ilioinguinal nerves, with consequent risk of inducing inguinal hernia, than by a single incision down one line into the belly.

Dr Dawbarn said that Bassini's recent figures were not very favorable as to the occurrence of relapses after his method of operation, when compared to the best percentages, and one reason for this probably was that he made no mention of the necessity of so dissecting, both superficially and beneath, as to free the conjoined tendon so that it would drop down to Poupart's almost of its own weight, and not be dragged unwillingly down by the stitches. Another unfavorable point was that Bassini allowed his patients to get up and leave the hospital on the eighth day, which the speaker thought was too early for the strain of the upright posture.

When this subject came up for discussion at a meeting of this Society a few years ago, Dr Arpad G Gerster brought out a very valuable point as to a probable etiological factor in the recurrence of hernia, namely, that many of these operations were done on hospital patients whose general condition was often below par, from disease or dissipation or both, and where we had to operate, so to speak, upon shoddy cloth, as contrasted with the wearing qualities of sound clothing of good quality, and naturally, the shoddy material easily gave way again upon subsequent strain.

DR MOSHCOWITZ said he agreed with Dr Taylor that the inclusion of these nerves in the suture should be avoided, as such a pinching of the nerve might give rise to a subsequent neuralgia.

As to the cause of recurrences after operations for inguinal hernia, Dr Dowd emphasized two points, *i e*, adequate suture and the preservation of the nerve supply. To these, the speaker said, he would add high ligation of the sac. In considering an operation for the radical cure of inguinal hernia we should have in mind not only the condition of the patient immediately after the operation or while he was still on the operating table, when every case was a radical cure, for the time being at least, but the condition of that patient six months afterwards or longer. Personally, he was inclined to believe that in many cases the sac was not ligated sufficiently high and the muscle slipped back to its original position. To illustrate this, the following case was of interest.

A member of his household was operated on for inguinal hernia by a surgeon of high repute. Six months later there was a recurrence, and at the second operation, which was done by Dr Moschcowitz, it was found that, with the exception of an occasional fine cicatricial adhesion, the transplanted muscles were not attached to Poupart's ligament.

The crux of the entire matter, the speaker said, was first to select the proper operation, then isolate and ligate the sac sufficiently high up and use adequate suture material. The transplantation of the cord should be done only in direct hernia.

DR JOHN B. WALKER said he saw many cases of recurrent hernia at Bellevue and at the Hospital for the Ruptured and Crippled, and almost invariably, at the second operation, he found that the transversalis muscle had broken loose from Poupart's ligament. The reason for this, he thought, was that the sutures uniting the transversalis and internal oblique to Poupart's ligament were not placed deep enough, that is, they did not include a sufficient mass of muscle and unite it to the lower shelving edge of Poupart's ligament, further, the neck of the sac was not dissected free and ligated high enough. When Dr Lorthior of Brussels was here at the meeting of the International Surgical Congress in April, 1914, he operated at the Ruptured and Crippled, using the method which he has employed most successfully in over 5000 cases of children, to dissect out the sac to an extremely high level, it was then cut off but *not* ligated, whereupon it retracted to a high level much above the internal ring. In cases of children, only two catgut sutures were used to unite the edges of the transversalis and internal oblique to Poupart's ligament. Most excellent results followed this very simple technic.

DR GEORGE WOOLSEY said that in the hypogastric branch of the iliohypogastric nerve we had mainly a sensory nerve, the muscular branches being given off higher up, the fibres of this nerve, when it appeared in the course of the usual incision for an oblique inguinal hernia, were sensory or trophic. While it was wise, as several of the speakers had said, to avoid pinching these fibres in the sutures, their importance in preserving the muscular tone of the conjoined tendon was questionable.

As to the cause of a recurrent hernia, the speaker said he could not quite agree with the statement made by Dr Moschcowitz. In a case where he did the second operation a few days ago the internal oblique muscle was well united to Poupart's ligament, and yet there was a recurrence in the form of a direct hernia. Such had been his usual

experience, and it was for that reason that not many years after the Bassini method was first introduced he abandoned the typical Bassini because he could not satisfactorily close the structures around the external ring to guard against this type of recurrence. He adopted a modification of the Halsted method by suturing the upper edge of the aponeurosis, with the conjoined tendon, to the deep surface of Poupart's ligament and overlapping the lower flap of aponeurosis on the upper flap. The cord is transplanted and lies superficial to the aponeurosis. This method was described independently by Andrews, and gave him much better satisfaction.

DR LYLE said that after hernial operations the theory of keeping the patient's legs flexed was a very old one, dating back to the middle ages. The Albanians were long famous for their treatment of hernia, one essential feature of their treatment being the flexion of the leg on the abdomen. They strapped their patients to a board and, after scarifying the external ring, flexed the thigh on the abdomen and kept the limb in this position until healing took place.

DR WILLIAM A. DOWNES said the paper of Dr Dowd emphasized the importance of preserving the integrity of the iliohypogastric nerve as a possible factor in the prevention of recurrence of hernia, and that it should help teach us to be a little more careful in doing the operation.

As to neuritis or pain following operation for hernia due to pinching of the nerve in one of the sutures, the speaker said he could not recall a single instance of that kind unless the pain was due to a hæmatoma or some infection. Neuralgia or neuritis due to inclusion of the iliohypogastric or ilioinguinal nerve in the suture must be of very infrequent occurrence.

As to recurrent hernia after the Bassini operation, Dr Downes thought they were practically all of the direct type. An arrangement of the sac that was not infrequently overlooked at the time of operating was the presence of a so-called double or saddle-bag variety of sac, and the condition was not in reality a recurrence, but an unrelieved hernia. As a matter of fact, recurrent hernia was much less common than one would expect, and the average operation for hernia gave quite satisfactory results. In his own experience for a period of ten years, from 1902 to 1912, inclusive, he operated on 582 cases of adult hernia at the General Memorial Hospital in the service of Dr William B. Coley, 25 per cent of which were bilateral. Of this total number of 582 cases, there were only 21 that had been operated on for hernia at some previous time and where a recurrence had taken place, which was really a small

percentage when the fact was taken into consideration that the patients came from many sources

As to the failure of the internal oblique and transversalis and Poupart's ligament to remain united, the speaker thought this was largely due to the fact that there was a deficiency or absence of sufficient muscle tissue, and that it was very often necessary to use the rectus muscle to help out

DR WILLIAM C LUSK said that in operating upon recurrent inguinal hernia, he had observed the same relationship between the arched fibres of the internal oblique and transversalis muscles and Poupart's ligament mentioned by Dr Moschcowitz, namely, that there was nowhere contact between these structures, the arched fibres being found back in their normal position. He regarded the restored normal relationship of these structures following an operation for inguinal hernia as probably due to the sutures not having held long enough for adequate union to have taken place

He said that Dr Halsted had early called attention to the importance of freeing the neck of the sac high so that the tied-off stump would retract well behind the abdominal wall out of the way of the suture line, which repaired the hernial defect. In a direct hernia Dr Halsted turned back a flap from the anterior sheath of the rectus, which he sewed to Poupart's ligament to repair the inner portion of the floor of the inguinal canal. He did not, however, transplant the rectus muscle. Dr Lusk said that in direct hernia he followed Dr Halsted's method, a technic of doing which as well as of transplanting the rectus muscle he had once demonstrated before the Society (*ANNALS OF SURGERY*, LVIII, 1913, p 675). In those inguinal herniæ where the arched fibres and conjoined tendon could not be brought down to Poupart's ligament without tension, Dr Halsted made a vertical incision through the anterior rectus sheath, cutting downward to the pubic bone, to afford relaxation to the former structures. Dr Lusk said he had tried this manœuvre and found it serviceable. Little was ever said specifically about the repair of the transversalis fascia which formed a large part of the floor of the inguinal canal and was, therefore, an essential barrier in maintaining the integrity of the abdominal wall in this region. One step which he was in the habit of practising in the operation for oblique inguinal hernia was after the sac had been dissected free from the transversalis fascia at the internal ring and had been tied off, to close the opening in the transversalis fascia at the internal ring before suturing the muscles to Poupart's ligament. This procedure made a normal

repair at the only situation where the integrity of the floor of the inguinal canal had been broken through and at the only situation as well where recurrence would be most likely to take place in this form of hernia

DR DOWD, in closing, said that before writing this paper he had consulted Prof George S Huntington, the head of the Anatomical Department of Columbia University, who stated that the fibres of the iliohypogastric nerve are so given off that the nerve should be preserved in this operation. Dr John C Vaughan, Instructor in Anatomy, also made a number of dissections and saw the fibres of the nerve running into the muscle. If the nerve is cut above the place where these fibres branch from the main trunk, the vitality of the parts which they supply must in a measure be diminished, also that of the corresponding portion of the external oblique aponeurosis. In the course of operation for recurrent hernia, he had seen firm union between the internal oblique and transversalis muscles and Poupart's ligament which had held for years. This union, however, was in the outer part of the suture line and not in the inner part. If the inner part had held, no secondary operation would have been needed. It is for the strengthening of this inner part of the suture line that nerve preservation is desirable. He believed proper suture much more important than nerve preservation, but the nerve should not be needlessly divided. He had not mentioned high ligation of the sac, or asepsis, because he considered these a part of the modern operation for hernia.

BRONCHIECTASIS FROM FOREIGN BODY

DR FRANK S MATHews showed the right lung, removed at autopsy from a girl of ten years, who in February, 1914, had been operated on for enlarged tonsils and adenoids. The child's illness dated from this operation. There was persistent cough, with free expectoration of pus, without odor. She spent several months in a hospital for the treatment of tuberculosis, where on repeated occasions a needle had been inserted into the right pleura, but pus was never evacuated.

When the girl was admitted to St Mary's Hospital for Children, several weeks ago, she was the picture of chronic sepsis. There was a wide range of temperature, with almost continuous cough and expectoration. There was dulness to flatness over the entire right chest, but nowhere were the breathing sounds absent, and they were generally of a bronchial character. The X-ray plate showed an appearance sug-

gestive of consolidation rather than of fluid in the chest. There was a suspicion of a cavity near the apex. The von Pirquet test was negative.

After several trials, the needle withdrew a small quantity of pus. A section of rib was then removed in the mid-axillary line, and the subjacent lung, which was slightly adherent, was inspected. The finger was pushed through a small amount of lung tissue and entered a cavity about finger-sized extending directly inward. Into this a tube was inserted and for a number of days the drainage was profuse. The child's general health improved so that the temperature fell and she was able to be about the ward. During an attempt to dilate the sinus wall there was a sudden violent hemorrhage coincident with a fit of coughing, and the child died.

The specimen showed an unusual condition of bronchiectasis affecting all the larger and moderate-sized bronchi of the right lung. The bronchi were everywhere dilated and contained pus or were lined with pyogenic membrane. In places, small bronchi communicated with cavities one or two centimetres in diameter just under the pleura. The latter was adherent about the drainage opening, but elsewhere was surprisingly free from firm adhesions.

Dr. Mathews considered this a case of bronchiectasis resulting from the aspiration of a foreign body into the bronchi—in this instance probably a fragment of tonsillar or adenoid tissue. He could recall two or three instances of lung abscess resulting from this cause that had come under his observation, and others had reported cases of bronchiectasis following the inhalation of foreign bodies into the lung.

DR DAWBARN mentioned a case as reported recently by Dr. Reed, of Washingtonville, N. Y., at a meeting of the West End Medical Society of New York, of abscess of the lung following a dental operation. The patient had had several teeth extracted, while sitting upright in a dentist's chair under gas, and as one of them was not recovered, it was supposed that it had been swallowed. The patient began to suffer from pain in one side of the thorax, and from a cough, and finally showed all the evidence of an abscess of the lung. He was operated on by a surgeon in Newark, N. J., and the tooth was recovered from the discharge. The patient ultimately recovered. The rarity of the case deserved a record, and this instance of inhaled adenoid tissue reported here to-night was quite similar in principle.

DR KAMMERER mentioned a case, which he had shown to the Society some years ago, in which he had removed the lower lobe of the left

lung The patient was a woman of thirty, upon whom many operations had been done for the cure of bronchiectatic cavities in the lower lobe, without any result During the last operation the entire lower lobe had been freed up to the hilum when a severe venous hemorrhage occurred, followed immediately by the aspiration of air, to which the patient succumbed in a few minutes At the autopsy a primary pedunculated carcinoma of the left bronchus was found, which had almost completely occluded its lumen

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TONSILLECTOMY IN CHILDREN FROM THE STAND-POINT OF THE GENERAL SURGEON*

BY DONALD C BALFOUR, M D.

OF ROCHESTER, MINN
(Mayo Clinic)

THE surgeon whose work is not restricted to a special field is frequently called upon to remove tonsils. Unfortunately with the laity, and too often with the surgeon also, there is a tendency to look upon this operation with more or less indifference and with a feeling that it is a comparatively simple one. Undoubtedly as the operation was carried out formerly, and, to a less extent, at the present time, it could be considered free of any technical difficulty, but this very simplicity was often the indirect cause of an incomplete operation and an unsatisfactory result. Attention has been drawn repeatedly to the fact that many children who supposedly had their tonsils removed have either failed to obtain relief for the symptoms for which they were operated on, or have later in life developed local or constitutional disturbances from hypertrophied stumps of tonsillar tissue.

In spite of considerable uncertainty as to the exact function of the normal tonsil and of much protest both in the lay and medical press against the so-called "slaughter of the tonsil," it is true that diseased tonsils are often the source of ill health both in children and adults. To what extent the tonsil should be held responsible for various forms of arthritis, lesions of the gastro-intestinal tract, infections of the gall-bladder, tuberculosis, exophthalmic goitre, etc., remains to be elucidated by those who are investigating the subject. The work of Rosenow is particularly suggestive and promises important knowledge along this line. Inasmuch as such strong differences of opinion exist as to the rôle the tonsil plays in various conditions of obscure etiology, one should exercise careful judgment as to the necessity or advisability of tonsillectomy.

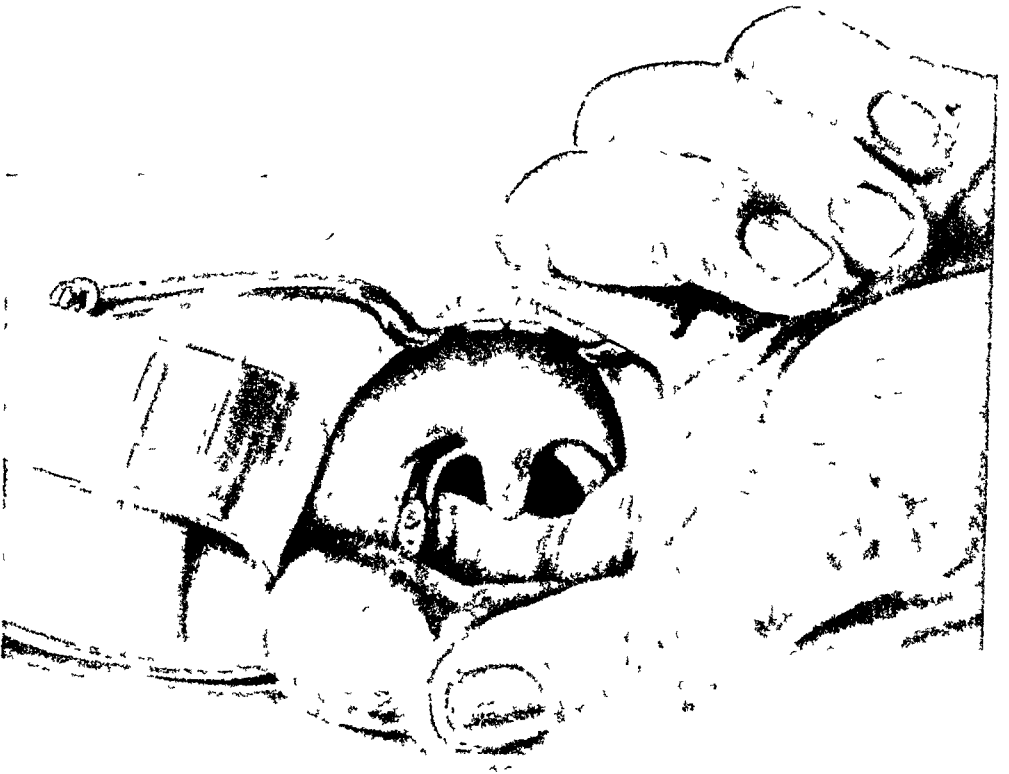
* Presented for publication December 2, 1914.

Without entering into a detailed discussion of the indications for the removal of the tonsils, it seems logical surgically that if the tonsils are visibly diseased or obstructively enlarged, or if they can reasonably be considered the atrium of infection for some local or constitutional disturbance, both glands should be entirely removed. While tonsillectomy is now rather generally advocated as the operation of choice, yet it is not consistently carried out. For instance, statistics from the New York public schools, where investigation of the condition of the throat following tonsil operations was made, show that in 10 per cent of the children there had been mutilations of the soft parts surrounding the tonsil, of those operated on without general anæsthesia, 90 per cent of the operations were badly done, and of those operated on under general anæsthesia, 25 per cent of the operations were badly done.

Assuming in a given case that the advisability of tonsillectomy is apparent, what method should the general surgeon adopt if he is to do a complete and effective operation? Numberless instruments are offered to make the operation easy. Practically all of these are based on the guillotine principle and are modifications of it. It is significant that the surgeons of greatest experience with these instruments admit a varying percentage of cases in which the instrument could not be used or failed to remove the entire tonsil, necessitating resort to dissection to complete the operation. It is therefore true that dissection properly performed will accomplish tonsillectomy in 100 per cent of cases, while any of the modified guillotine operations will prove inefficient in a varying percentage of cases.

Dissection cannot be advocated as a uniformly easy method for tonsillectomy varies in difficulty just as do most surgical procedures. In difficult cases the operation, if properly carried out, that is, without damaging trauma to the faucial pillars or other surrounding soft parts and without risk of hemorrhage, infection, etc., cannot be classed as a "minor" one. Further, statistics show that the operation is not devoid of these serious complications, or even of mortality. It thus seems incumbent to select some method which is safe as well as adequate.

The importance of an anæsthetic administered by one who is accustomed to inducing the particular anæsthesia which is desired in these cases is quite evident. Failure in this regard is often the cause not only of unsatisfactory operations, but of other disastrous consequences. The child must be thoroughly asleep so that unabolished reflexes will not interfere with the dissection, but the depth of anæsthesia should not exceed a point which is just commensurate with the average length of time necessary for the removal of the tonsils. It is not objec-



Ralph Sweet
1914

FIG. 1 — Finger behind posterior pillar elevating tonsil



FIG. 2 — Anterior pillar separated and pushed from capsule of tonsil

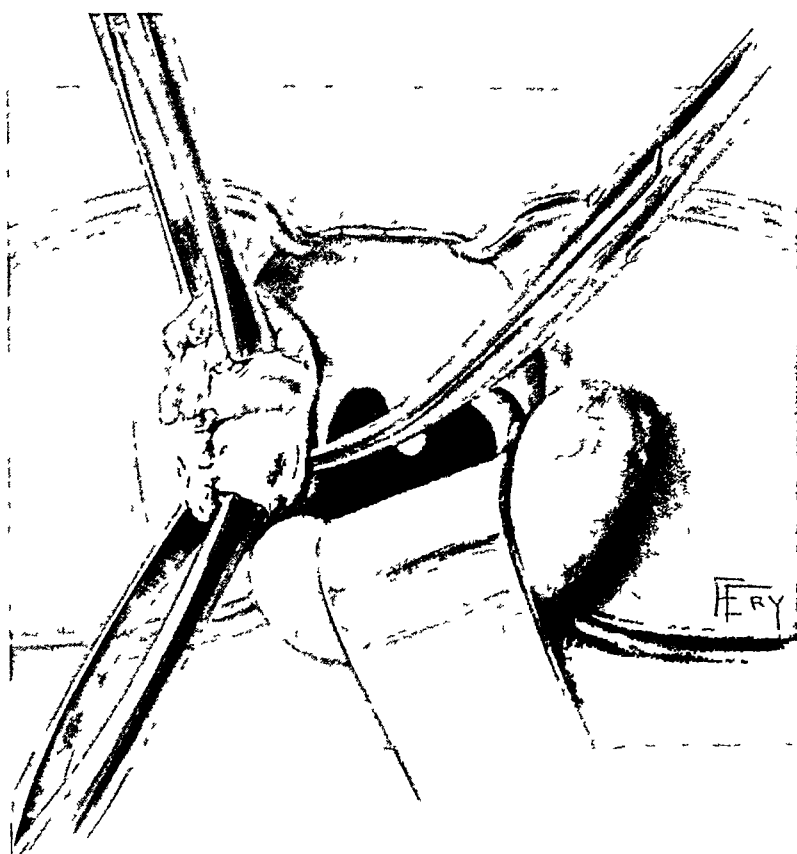


FIG 3 —Tonsil turned and dissection completed by separating posterior pillar

TONSILLECTOMY IN CHILDREN

tionable for the child to show signs of returning consciousness when the first tonsil has been removed. More ether can then be administered, while a little pressure with the gauze-covered finger may be advantageously applied to the recess from which the tonsil has been removed. The ideal anæsthesia is one which is sufficient for the operation yet light enough so that the patient is already returning to consciousness by the time the operation is completed.

Dissection offers the least liability to primary or secondary bleeding. In this regard lies one of the most important advantages which the dissection method possesses. In only one case has hemorrhage been seen in the cases operated on by this method which caused any concern and that was readily controlled by suture. The absence of bleeding is due mainly to the fact that removal of the entire tonsil permits the tonsillar vessels to retract into the muscular wall of the pharynx. The slight hemorrhage differs strikingly from that which often occurs from the tonsillar stump following tonsillotomy.

As to the special technic of the operation, there is much less to be said than to be acquired. A modification of the Waugh method was introduced into the Mayo Clinic some four or five years ago by Beckman. It has proved satisfactory in the 1654 cases which were operated on under anæsthesia from January 1, 1909, to December 1, 1914.

Good anæsthesia is the first essential. The position of the child should conform to the individual preference of the operator. We prefer the child lying with the head free over the head of the table, which should be slightly lowered. The child's head is supported by the hands of an assistant who stands at one side of the table. On the opposite side is an assistant who aids by traction of the tongue, sponging, etc., while the operator stands at the head of the child between the two assistants.

A Whitehead mouth gag without the tongue depressor is fixed in place. The operator's index finger is introduced behind the posterior pillar of the tonsil, and by firm upward traction of the tonsil the anterior pillar is put on the stretch. With blunt dissecting scissors or tissue forceps the pillar is then well freed from the anterior surface of the tonsil, care being taken not to break through the capsule of the tonsil. This enables the operator, by means of the supporting finger behind, to force the tonsil well forward and to securely engage the tonsil with a tenaculum (Fig 1). Ordinary uterine tenacula, although they have a tendency to tear into a soft, friable tonsil, when carefully manipulated are very satisfactory for this purpose.

The tonsil, firmly held, is turned over, so to speak, to expose

the posterior pillar, and this is freed usually by blunt dissection (Fig 2) The superior pole is now enucleated from the superior tonsillar fossa and, in the majority of cases, the tonsil may then be rolled out of its bed without any more than blunt dissection In very adherent glands one proceeds, first well separating the pillars, following by blunt dissection where possible, or by careful clipping with the dissecting scissors, until the tonsil is entirely freed from the pharyngeal wall

This method enables the operator to actually see what he is doing, and, for this reason particularly, possesses distinct advantages as a precise and safe operation in the hands of the competent general surgeon who has acquired the technic and who appreciates the fact that the operation demands skill, care and experience

MECHANISM OF THE PRODUCTION OF HEMORRHAGIC EROSIONS OF THE ŒSOPHAGUS AND OF SOME ASSOCIATED LESIONS IN ILEUS*

BY BENJAMIN F. DAVIS, M.D.

OF CHICAGO

NICHOLAS SENEY FELLOW IN SURGERY, RUSH MEDICAL COLLEGE

(From the Laboratories of Pathology and of Surgery of Rush Medical College.)

HEMORRHAGIC erosions of the œsophagus are among the rarities in the literature of pathology. Three cases are mentioned by Meyer¹ as occurring in infants with *malena neonatorum* and Kaufmann² reports the occurrence of the lesions in a girl of twenty who died from the effects of a severe burn. Diligent search through the available literature has failed to reveal further examples.

According to Kaufmann hemorrhagic erosions appear in the lower portion of the œsophagus as sharply circumscribed patches from a fraction of a millimetre to a centimetre or more in diameter, more or less oval in outline, sometimes arranged in series brownish, superficial or invading the submucosa, and often in great numbers. The surrounding mucosa may be undermined.

Kaufmann believes that hemorrhagic erosions in the œsophagus may arise through the same agencies that are responsible for their production in the gastric mucosa. When small mucous or submucous gastric hemorrhages undergo partial digestion by the gastric juice so that there results a loss of substance, they become the so-called hemorrhagic erosions. Such small hemorrhages are usually due to passive hyperæmia, as in heart disease, cirrhosis of the liver, pulmonary emphysema and excessive vomiting. Not rarely they are agonal lesions. They may become confluent, and form large irregular blotches from which fatal hemorrhage sometimes occurs, they may follow as the result of severe infectious diseases: of the hemorrhagic diathesis: of the action of endogenous poisons as in uræmia and cholæmia: or of exogenous poisons as phosphorus arsenic mercuric chloride, acids and alkalis. They may be embolic as in endocarditis, pneumococæmia or streptococcus sore throat. Experimentally and clinically lesions of the central nervous system and of the suprarenals³ have been causally associated with gastric hemorrhages. The latter have also been described in hysteria and as an expression of vicarious menstruation.

Gastric and duodenal hemorrhages (very rarely œsophageal) appear-

* Reported at the Chicago Pathological Society, October, 1912.

ing in the first few days or week of life, and sometimes leading to ulceration, may be due to brain lesions following birth injury, or to embolic vascular occlusion following thrombosis in the umbilical vein with either crossed (ductus Botalli) or retrograde venous embolism

Of great clinical interest are the post-operative gastric and intestinal hemorrhages which follow laparotomies especially, and more especially those in which omental vessels have been ligated ⁴ They result from direct and retrograde thrombosis in the arterial as well as in the venous system Such thrombi frequently are septic The hemorrhages appear once or more, usually in the first week, and the pathological changes consist of hemorrhages, erosions and ulcerations In appendicitis similar changes arise through retrograde embolism, the emboli coming from the omentum, appendix or mesentericolum Payr ⁵ has produced gastric hemorrhages, erosions and ulcers through retrograde embolisms in the portal system, Friedmann and Hamburger ⁶ and others by direct embolism, and Rosenow ⁷ by the intravenous injection of streptococci of a certain grade of virulence and with a marked affinity for gastric tissue

Excessive vomiting is said to cause gastric hemorrhages through the marked venous hyperæmia resulting on the crests of the folds of mucosa which are thrown up when the volume of the stomach is much reduced under pressure The hyperæmia would be particularly noticeable in case the act of vomiting were associated with extreme and prolonged contraction of the gastric musculature Œsophageal hemorrhages as a result of vomiting appear to be relatively rare, though Schultz ⁸ describes two fatalities from this complication The lesion in each of these patients, who were in the midst of an alcoholic debauch at the time the accidents happened, consisted of two linear tears in the mucosa at the cardiac orifice in one, and at about the level of the cricoid cartilage in the other The tears, as seen at autopsy, were quite fresh, 2 or 3 cm in length, about 5 mm in width, tapering to an acute angle at each end There were no varicosities, foreign bodies nor history of instrumentation

In ileus, hemorrhagic erosions of the œsophagus and stomach may be due to any one of the causes of mucous and submucous extravasations mentioned in the preceding paragraphs The evidence in the case to be described, however, seems to offer an explanation of their occurrence which has not been advanced heretofore and which may become worthy of consideration in connection with the operative treatment of intestinal obstruction, and with the theory of the relation between toxin production by the intestinal mucosa and death from ileus

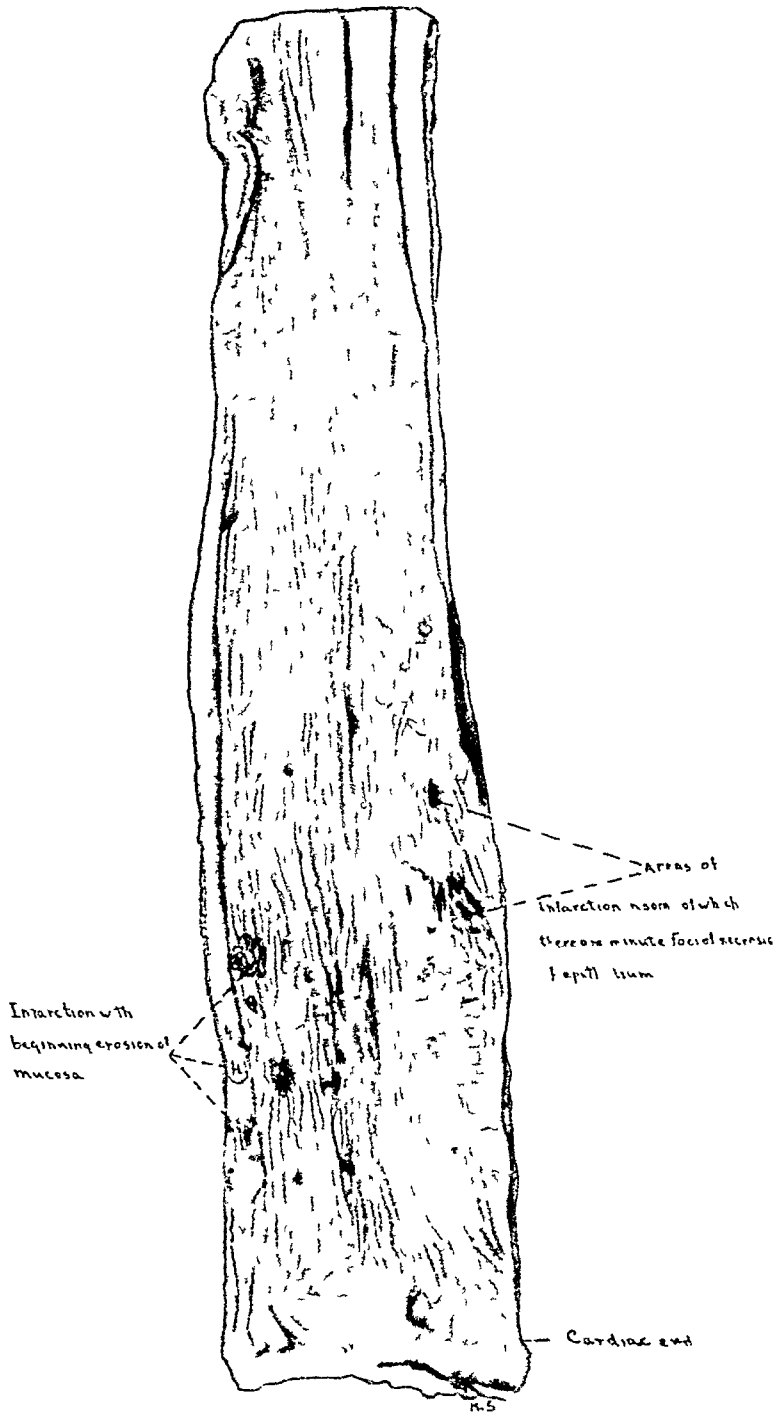


FIG. 1 —Lower nineteen centimetres of œsophagus (three-fourths natural size) showing areas of thrombosis infarction and hemo-rhagic erosion

HEMORRHAGIC EROSIONS OF THE ŒSOPHAGUS

In November, 1911, Dr E Wyllys Andrews operated upon a man for intestinal obstruction of three days' duration at the Cook County Hospital. At the operation the obstruction was found due to a band of adhesions about three inches above the ileocecal junction, a beginning peritonitis was also found. The intestine proximal to the obstruction was markedly distended, and distally collapsed. The bowel was drained of its contents through an incision which was later closed with a purse-string suture, and an ileocolostomy was done. The patient died a few hours after the operation. At a post-mortem examination, made by Dr LeCount, the following anatomic diagnosis was made: acute serofibrinous peritonitis, laparotomy wound (recently made), enterocolostomy, sutured hole in the small bowel, multiple regions of infarction of the small bowel and mesentery due to thrombosis of the mesenteric veins, dilatation of the small bowel, empty colon, large region of red infarction of the liver (Zahn), multiple regions of thrombosis, hemorrhagic infarction and ulceration in the œsophagus, marked senile sclerosis of the aorta with atheromatous ulcers and adherent fibrinous masses, healed infarct of left kidney, marked cloudy swelling and fatty changes in both kidneys, bilateral fibrous pleuritis, marked anthracosis and senile emphysema of the lungs, undescended cæcum, hemorrhages into the gastric mucosa.

Of these alterations there are several deserving special attention. First, the dilatation of the small bowel—this was extreme at the time of operation, was relieved by enterostomy, and was again quite marked at autopsy. Second, the areas of thrombosis, infarction and hemorrhage in the mesentery and small intestine—the infarcts about six in number were distributed along the course of the bowel, chiefly in the jejunum, opposite the mesenteric attachment, as bluish elevations of the mucosa varying in size from that of a silver dollar to oval lesions four inches in length, in the central portion of some were narrow slit-like tears in the mucosa about an inch long, the contents of the bowel were bloody. Third, hemorrhages into the gastric mucosa—these were multiple, varying in size from a millimetre or two to that of a silver dime. Fourth, multiple areas of thrombosis, hemorrhagic infarction and ulceration in the œsophagus—these lesions were limited to a circular band in the upper three-fourths of the lower one-third of the œsophagus, they were approximately circular in outline and varied from 1 to 10 mm in diameter, in the fresh specimen, minute areas of necrosis of the mucosa were visible over the infarcts, but there was no post-mortem digestion, some of the lesions appeared recent with unbroken mucosa, while others seemed older, were brownish-black and

were the ones in which the minute areas of necrosis appeared, these lesions were essentially hemorrhagic erosions of the œsophagus. Fifth, a large region of atrophic, red infarction (Zahn) of the liver.

Microscopic study of the œsophageal and mesenteric lesions confirms in full the diagnosis of thrombosis, infarction and hemorrhage as made at autopsy.

Gastric distention, as has been shown by Burton-Opitz,⁹ may produce complete obstruction of the gastric circulation. Working on dogs it was found that air forced into the stomach squeezed the blood out of the vessels and flattened them, damming back the blood on the arterial side. If considerable pressure (30–50 mm Hg) were somewhat quickly applied, there resulted a sudden rise of venous pressure which was succeeded by a rapid fall, to rise again only when the intragastric pressure was relieved. An intragastric pressure of 50 mm Hg was always sufficient to stop the flow of blood through the intramural vessels of the stomach. Increased intra-abdominal pressure up to 70 mm Hg may likewise stop the portal circulation which may be restored by removal of the pressure.

The normal intragastric pressure in man varies between 6 to 19 and 20 to 162 cm of water in the cardiac and pyloric ends of the stomach respectively. In the dog the normal intragastric pressures are approximately the same as those in man. Pressures may rise much above these figures in portions of intestine cephalad to a point of obstruction. Richards and Ruggles¹⁰ fastened a recording apparatus in the intestine of a cat and found that the pressure in the obstructed region varied between 60 and 120 mm Hg, and that when ergot and physostigmin were given these figures were greatly exceeded—pressures amply sufficient to cause complete arrest of the circulation in the portion of bowel involved.

From the stand-point of pathological anatomy, it is recognized that intestinal distention may lead to anæmia of the bowel wall with stasis and thrombosis in the mesenteric blood-vessels, leading occasionally to necrosis of the mucosa with the formation of so-called "dilatation ulcers."¹¹ The order in which this train of lesions develops is described as follows: "intestinal distention, venous stasis, thrombosis, hemorrhage, necrosis, ulceration." The importance of the rôle of vasomotor paralysis and of the toxicity of infectiousness of the intestinal contents in the production of dilatation ulcers is uncertain. Experimentally where the presence of powerful toxins has been demonstrated, not only in intestinal contents but also in the intestinal mucosa, submucous hemorrhages with ulceration occur frequently but not invariably.¹² When they do occur there is always an associated intestinal distention, thus

making it appear that the latter may be the important factor in their production

In an obstructed bowel, interference with the circulation probably develops as follows. The segment of bowel immediately cephalad to the obstruction is thrown into violent peristaltic contraction, increasing intra-intestinal pressure tremendously and squeezing most of the blood out of the intestinal capillaries. The peristaltic contractions increase in number and duration, in some cases developing into a tonic spasm of entire loops. Gradually exhaustion of the intestinal musculature thus devascularized makes its appearance, and the bowel slowly yields to the pressure of the contained secretions and gas, finally ballooning out to form, in the earlier stages, the areas of regional distention (known clinically as von Wahl's sign), and later the general tympanites of ileus. As the increased intra-intestinal pressure from muscular contraction closed the intramural capillaries of the bowel in the first instance, so the pressure of the intestinal contents and the stretching and flattening of the capillaries in the distended portion tend to maintain that closure in the second. Thrombosis from stagnation is one of the results.

In the present case conditions seem to have been about as follows. There was first marked increased intra-intestinal pressure. This caused collapse and occlusion of the thin-walled vessels in the intestinal wall, with resulting stasis in the mesenteric vessels, in many of which thrombi presently formed. Meanwhile, with approximately the entire circulation through the small intestine shut off, the flow of blood through the portal vein became much reduced in volume, and, as a result, the rate of flow through the fine venous radicles in the gastro-œsophageal anastomosis, never very rapid, probably, under normal conditions, practically ceased and thrombosis from stagnation occurred. At the operation the distention of the bowel was suddenly relieved, there was a sudden influx of blood into the portal system with almost explosive hemorrhagic infarction of the more extensively thrombosed areas in the intestines, with occasional rupture of the mucosa and escape of blood into the bowel lumen, and the more gradual infiltration of the thrombosed areas in the œsophagus. Simultaneously, many of the small thrombi in the mesenteric vessels were swept out into the portal vein and carried to the liver, there producing extensive infarction.

Hartwell and Hoguet¹³ and Gurd¹⁴ have suggested upon the basis of experimental work that the powerful poisons described by Whipple¹² and his associates in the contents and in the mucosa of closed intestinal loops are the results of tissue autolysis. It is universally agreed that

the prognosis in intestinal obstruction from any cause becomes doubly serious the moment that vascular injury develops. Tissue autolysis follows as a result of vascular injury. The manner in which increased intra-intestinal pressure may produce vascular injury has been discussed in the preceding paragraph. Therefore the suggestion that increased intra-intestinal pressure may be of primary importance in determining the onset of intoxication demands consideration. Experimentally there seems to be no doubt but that loss of water is of extreme importance in producing the early symptoms of collapse in ileus and that, given sufficient water to replace that lost in the vomitus, urine, etc., a dog's life is not immediately imperilled.¹³ He suffers from starvation. His metabolism becomes that of a starving animal—unless vascular injury is produced, when the occurrence of death becomes but a matter of hours.

The complications or sequelæ of intestinal obstruction appear to be intimately related to local vascular alterations. They are given by McGlannan¹⁵ as follows: (1) toxæmia, (2) gangrene, (3) peritonitis, (4) renal disturbances. To this list must be added a fifth complication, namely, dehydration, the importance and probable cause of which have already been suggested, as has also that of toxæmia. Renal disturbances are probably due to the above two factors. Gangrene, as the result of vascular disturbance, and peritonitis, developing through the escape of bacteria from intestines, the seat of injury from vascular disturbances, need but to be mentioned to be appreciated.

One of the common symptoms of ileus is paroxysmal, cramp-like pain which is commonly attributed to tension on mesenteric attachments. Might not this pain be produced in part by local tissue asphyxia, the result of vascular disturbances produced by the prolonged and violent contraction of the intestinal musculature, in other words, by increased intra-intestinal pressure?

The evidence serves to emphasize anew the necessity of early operative interference in intestinal obstruction, of operation before extensive vascular changes have been induced. It suggests a reason why relief of the obstruction and drainage of the bowel even in the absence of infection fail to save a considerable proportion of patients—those in whom thrombosis in the capillaries of the bowel wall and in the mesenteric veins prevents the efficient re-establishment of the circulation upon the removal of the intra-intestinal pressure. It also suggests caution against the too sudden relief of this pressure because of the danger, first, of embolism, second, of acute explosive hemorrhagic infarction.

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of portions of bowel in which the vascular apparatus might be able to accommodate a gradual return of the blood but would be overwhelmed by its sudden influx ; and third, of serious hemorrhage into the intestinal lumen from rupture of the mucosa over areas of explosive infarction

I wish to acknowledge the courtesy of Dr E Wyllys Andrews in giving me opportunity to utilize the clinical observations reported

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THE SURGICAL ANATOMY OF THE UPPER AND LOWER POLES OF THE THYROID GLAND WITH REFERENCE TO THYROIDECTOMY*

BY NATHANIEL GINSBURG, M D
OF PHILADELPHIA

OPERATIVE procedures upon the thyroid gland are rendered difficult or simple in execution largely by the anatomical factors determining the disposition of the blood-vessels related to the upper and lower poles of this body. Accessibility of these vessels is not always easy, owing to the distortion of the gland mass by overgrowth, with consequent upward and downward extension, and displacement of the usual landmarks commonly noted to definitely localize the vessels entering the gland substance.

Severe hemorrhage not infrequently attends partial removal of the thyroid gland owing to retraction of the vessels (usually veins) after incision, or as the result of failure of a ligature to include all the vessels. The troublesome bleeding during the course of this operation is usually ascribable to the veins whose number and size are far greater than the standard text-book descriptions lead one to believe.

Close studies in the anatomical laboratory of the University of Pennsylvania over a number of years, with careful inspections of many hundreds of thyroid glands, dissected in normal position, has impressed the writer with the frequency of the anomalous distribution of the thyroid vessels, particularly the veins (Fig 1). Clinical evidence to corroborate these views has also been found by the writer in operations upon the thyroid body in the living.

Isolation of the superior thyroid artery is always a simple matter because this vessel is invariably directly related to the upper apex of the lateral lobe, dividing, however, before it penetrates the substance of the gland. The distribution of the blood stream is over the ventral gland surface, a dorsal branch of some size, however, continuing down the dorsomesial surface of the lobe to form an anastomotic channel completed by an ascending branch of the inferior thyroid artery. It is from this anastomotic channel that the parathyroid glands hang and therefore derive their blood supply. Since the division of the superior

* Read before the Philadelphia Academy of Surgery, November 2, 1914

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thyroid into the two main stems often takes place at a distance of from two to three centimetres from the gland, the importance of grasping both vessels in a circumscribing ligature having for its purpose complete pole ligation is significant. It is not by any means difficult to miss the dorsal stem of this artery in passing the ligature, and hence the explanation of a failure to realize an expected improvement in a patient with a toxic goitre after complete single or bilateral ligation of the superior thyroids was thought to have been accomplished.

The superior thyroid vein is usually a single vessel, but, as shown in the illustration, possesses an anatomical relationship to the internal jugular vein, which may give rise to severe hemorrhage after apparent ligation of the superior thyroid vessels has been practised. This short, thick venous trunk, passing transversely into the wall of the internal jugular vein, demands careful ligation, and this is safer than the application of a forceps. The writer was compelled during the past year to ligate the internal jugular vein in two patients, following the retraction of this vein which simulated a punctured wound of the vessel wall. This unusual procedure did not, however, in either instance, complicate the injury or offer any untoward cerebral effects.

The middle thyroid vein is fairly constant, short in length, and likely to be overlooked in lobectomy, especially since traction of the gland mass toward the median line often reduces this vessel to a collapsed thin cord which bleeds freely, if incised, when release of traction takes place.

Occasionally the inferior thyroid artery is wanting on one side, and a huge superior thyroid artery compensates for its absence. Obviously, this anatomical state would be ideal for polar ligation as a surgical procedure, and would rob the whole lobe of a large part of its blood supply. No example of an absent superior thyroid artery has been noted, although this vessel has been seen to arise from the common carotid artery. (This observation was made in the Anatomical Laboratory.)

The inferior thyroid artery is considerably larger than the superior thyroid, and has a more direct origin from the parent vessel (subclavian). Owing to its greater size and glandular distribution, it delivers a greater blood supply to the thyroid gland than its fellow of the same side. It passes vertically upward and thence medianward behind the carotid sheath, and always divides into a number of large glandular branches before entering the gland tissue. The division is opposite the centre of the gland lobe, and this vessel is mistakenly thought by some to have a relationship to the lower pole of the lobe similar to the arrangement which the superior artery bears to the upper

pole The inferior laryngeal nerve (motor to the larynx) is intimately related to the main glandular branches as they pass across the lateral tracheo-oesophageal sulcus, passing between two or more branches or lying dorsal to all of them

Ligation of the inferior thyroid artery before division requires retraction of the carotid sheath either lateralward (Halsted), or medianward (Rogers), extending the dissection beyond the confines of the gland capsule, and cannot be easily accomplished through a small incision Ligation of the main branches before they enter the gland is attended with danger, since the motor laryngeal nerve may be included in the ligature The peripheral ligation of the vessels in the gland substance, with retraction of the lobe toward the median line, spares both the nerve and the parathyroids and has been the procedure adopted since advised by Kocher, Halsted and Mayo This method does not ligate the inferior thyroid *en masse*, but makes possible the plastic resection of the lower pole, and is the theory upon which Mikulicz based his suggestion of plastic gland resection, which has been recently mentioned in an excellent paper by Balfour of Rochester, Minnesota

Rogers of New York advocates quadruple ligation of the thyroid vessels, with nerves included in the ligatures, and reports thirty-six cases of typical exophthalmic goitre operated upon prior to January 1, 1913, by this method He approaches the lower arteries through a vertical incision over the lower end of the posterior border of the sternomastoid muscle "The approach exposes and passes in front of the phrenic nerve on the scalenus anticus muscle The inferior thyroid can then be felt and reached behind the internal jugular vein and common carotid artery"

The conception of this procedure is fundamentally based upon a certainty of accomplishing a reduction of the glandular arterial burden, and no other operation upon the thyroid save total excision will equal it in this respect The results reported by Rogers upon the thirty-seven cases offers incontestable proof of the value of his procedure This writer also attempts to explain failure in two of his earlier cases, following quadruple ligation of the thyroid vessels and nerves, in which improvement became stationary, upon the operative findings at the second operation He states, "exploration revealed a reformation of one or more collateral branches at the primary operation It is technically difficult to be sure of securing all the twigs given off from the superior thyroid, especially in a nervous subject under local anæsthesia"

It is evident from these latter statements, that at the primary opera-

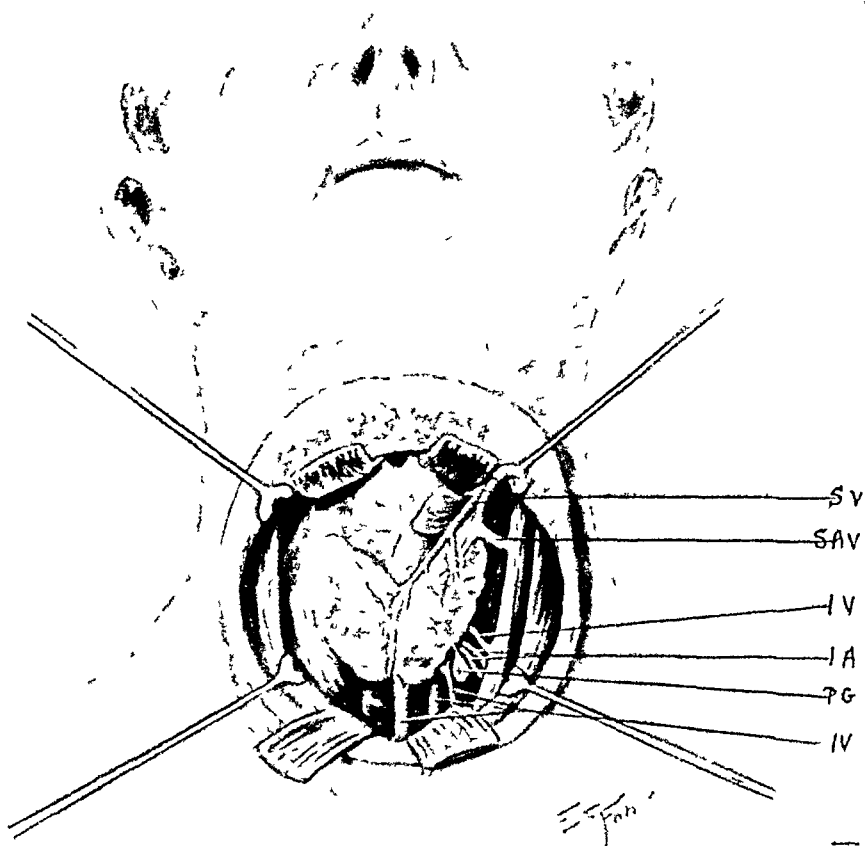


FIG 1—S I superior vessels, S I V superior accessory vein, I I inferior thyroid veins, I A inferior thyroid arteries, P G parathyroid gland. Note the venous arrangement at the superior pole of the gland the short vein passing outward at right angles to the gland to enter the internal jugular vein. The inferior vessels are numerous and the veins are very large. Note the large inferior median vein descending along the trachea. Ligation of the inferior thyroid artery before it breaks up into its branches does not affect the venous return from the gland.

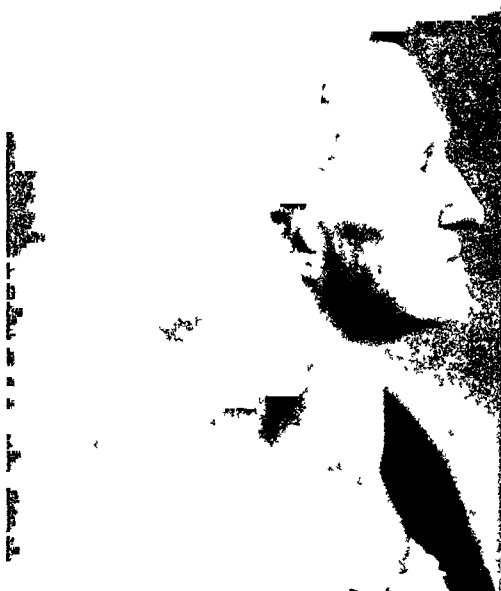


FIG 2—L. K. aged fifty years. Toxic exophthalmus. Duration of goitre eight years. Weight at operation eighty pounds. Emaciation marked. Bilateral ligation of superior poles of thyroid. Recovery so marked that further operative treatment was unnecessary.



FIG 3—L. K. aged fifty years. Same as Fig 2. Note large left lobe and isthmus.



FIG 4—E M single aged twenty-seven years Intensely toxic goitre Bed ridden for three months Bilateral superior pole ligation had no effect Secondary right lobectomy with marked improvement

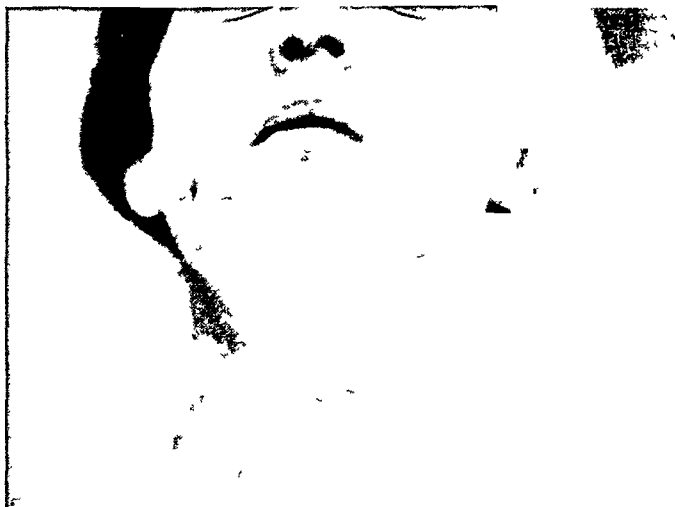


FIG 5—E M Note small size of goitre and moderate exophthalmus Duration of symptoms sixteen months

SURGICAL ANATOMY OF POLES OF THYROID GLAND

tions upon these two patients, Rogers may have missed in the superior pole ligatures the dorsal branches to the gland to which attention has been previously directed. It must not be forgotten that in toxic goitres, of the exophthalmic or non-exophthalmic type, either single or multiple ligation at best only affects the conduction to and from the gland of both blood and gland elements, leaving the increased secretory surfaces still intact, since Wilson and Plummer have proven beyond all doubt that hyperplasia of the thyroid is complementary to hyperthyroidism.

The very free anastomoses of the arterial system, and the great numerical constancy of the veins leaving the thyroid gland, should make one pause and wonder that a single or double polar ligature can very materially reduce the blood supply to this organ. The clinical evidence is incontrovertible in a large percentage of cases (Kocher, Mayo and others), but there are patients in whom no evidence of improvement is noted, following this attempt to diminish the thyrotoxicosis, by reducing the blood supply to the gland and the coincidental delivery of the secretion into the blood system. It is likely that failure in these cases is dependent upon the anatomical factor involving the vessels entering and leaving the gland. Dr. Halsted resorts to ligation of the inferior thyroid in preference to the superior vessels. His technic undoubtedly makes possible successful occlusion of the inferior thyroid artery, since the vessel is secured behind the carotid sheath before division into terminal branches takes place. His ligature, however, does not circumscribe the veins related to the lower pole of the lobe and in this respect the operation only accomplishes one-half of the same procedure applied to the superior vessels. The value of ligation attaches as much to venous occlusion as to arterial interruption, and an examination of the large veins, related to the lobes and isthmus below, will at once prove the truth of this observation. Halsted states that in his clinic preliminary ligation is always practised as the first stage of surgical treatment in cases of toxic goitre to improve the patient's condition and to test the resistance to operation. He further states, "that in no instance have we found that the preliminary ligation of two, three, or even of the four arteries, sufficed to cure the patient seriously ill with Graves' disease, although we have observed that considerable improvement, for a short time at least, may follow the ligation of even a single artery."

The writer performed a double superior pole ligation upon a patient *in extremis* (Figs 2 and 3), and following a stormy post-operative period, improvement was so marked that further surgical interference was refused and finally became unnecessary. In another case (Figs

4 and 5), in which long continued medical treatment reduced the patient to almost complete disruption, double ligation of the superior vessels utterly failed to change the clinical picture. Seven weeks after this operation unilateral lobectomy was performed, and the reason for the failure of the first operation became clear. The blood supply, interrupted by closure of the superior vessels, was more than offset by the abundance of blood entering and leaving the gland by numerous and large inferior thyroid vessels. Examination revealed a completely ligated superior pole on both sides, since the linen ligature was examined, and had circumscribed all the vessels entering this portion of the gland.

In spite of the fact that enucleation should be subcapsular and all manipulations carried on close to the gland, troublesome hemorrhage will often arise, and the purpose of this communication is to direct attention to some anatomical factors the knowledge of which will render excision of a part of this organ easy or difficult. Operations upon the thyroid now constitute one of the safest of all surgical procedures, and if toxic cases are treated early surgically, before prolonged medical treatment exhausts the patient, this operation will be placed in the category of results of operations for acute appendicitis when done within the first twenty-four hours.

URETERO-ENTERIC ANASTOMOSIS

A NEW ENTERO-URETERAL OPERATION

AN INDUCTIVE STUDY BASED ON SURGICAL PHYSIOLOGY

BY W HOWARD BARBER, M D.

OF NEW YORK

(From the Laboratory of Experimental Surgical Physiology, N Y University)

THE ureterovesical valves may be destroyed without resultant injury to the kidney tissue. This was amply shown by Draper and Braasch¹ at the Mayo Clinic in 1911.

The causative factors of ascending infection were further studied by Barber and Draper² and Stewart and Barber³ in 1913-1914. From a study of 42 dogs it was determined that

(1) When the ureters were "stripped" hydronephrosis followed in 75 per cent of the cases

(2) When the ureters were "stripped" and the valves were cut, renal infection ascending through the wall or the lumen of the ureter or both followed in 50 per cent. of cases

(3) When the ureteral vesical implantations were circumcised no kidney changes were observed

From a review of these conclusions it appeared that:

(1) If the ureters were transplanted without traumatization, preserving the ureterovesical valve or its equivalent was desirable

(2) If the ureters were traumatized in attempting transplantation, the absence of a ureterovesical valve or its equivalent was desirable

(3) And in either case transplantation of the ureter was in itself no causative factor, but a protective factor against ascending lymphatic infection

The problems of the anastomosis of the ureters and the intestine have been shock, peritonitis, cumbersome technic, difficult control of urination, colitis, leakage, hydronephrosis, and primary infective kidney. To these should be added and emphasized, the inevitable dis-

¹Draper and Braasch. The Function of the Ureterovesical Valve. Journal A. M. A., 1913

²Barber and Draper. Renal Infection, A Further Experimental Study of its Relations to Impaired Ureteric Function. Journal A. M. A., 1914

³Stewart and Barber. Hydronephrosis, an Experimental Study. ANN SURG., December, 1914

quietude of the surgeon arising from his ignorance of the intra-ureteral pressure

From a review of these conclusions it appeared that

(1) An operation removing the elements of shock, peritonitis and cumbersome technic must be brief, clean, and simple

(2) An operation removing the objectionable factor of difficult control of urination must result in normal sphincteric control

(3) An operation removing the occurrence of colitis must involve a mucous surface accustomed to or adaptable to contact with urine

(4) An operation to prevent leakage and allow cognizance of either the patency or stenosis of the ureter must have an effectual anastomosis and one open to investigation at any time

(5) Finally, a technic preventing post-operative hydronephrosis and primary infective kidney, if available, is to be found not by hit or miss methods based on anatomical findings, but only through the application of the recently acquired physiological knowledge of the ureter and kidney

The following operation is not recommended to clinicians for trial at the present writing. Its interest primarily lies in its being the logical sequence of physiological laboratory facts, applied to the recognized problems, incident to the uretero-enteric anastomosis. Of eight dogs so operated upon all survived operation, one alone died within the first week, following sloughing of the ureter from overtension. The others to all appearances resemble normal dogs. It is expected that the following technic shall remove the objections common to other operations and leave but one serious problem for consideration, namely, that of the balance of power and load pertained to every transposed ureter. For the ureter is necessarily traumatized and reduced in its motor efficiency and resistance is unavoidably piled up at its extreme caudad end. The problem, then, is simply so to reduce this terminal work that the already impaired ureter may physiologically meet it. The following technic is therefore proposed. A mesoventrad incision 5 cm long is made in lower abdomen. Identify the ureter and free it from its bed. Divide the ureter between two ligatures just cephalad to the bladder. Attach a straight cutting needle to the cephalad ligature and penetrate the sigmoid colon in a line perpendicular to its long axis. Drive the needle through at a point 90 degrees distant on intestinal wall, thus drawing ureter through each wall. The sigmoid is then suspended within the wound by the usual glass rod method. The ligated cephalad end of the ureter is allowed to protrude on to the skin where its liga-

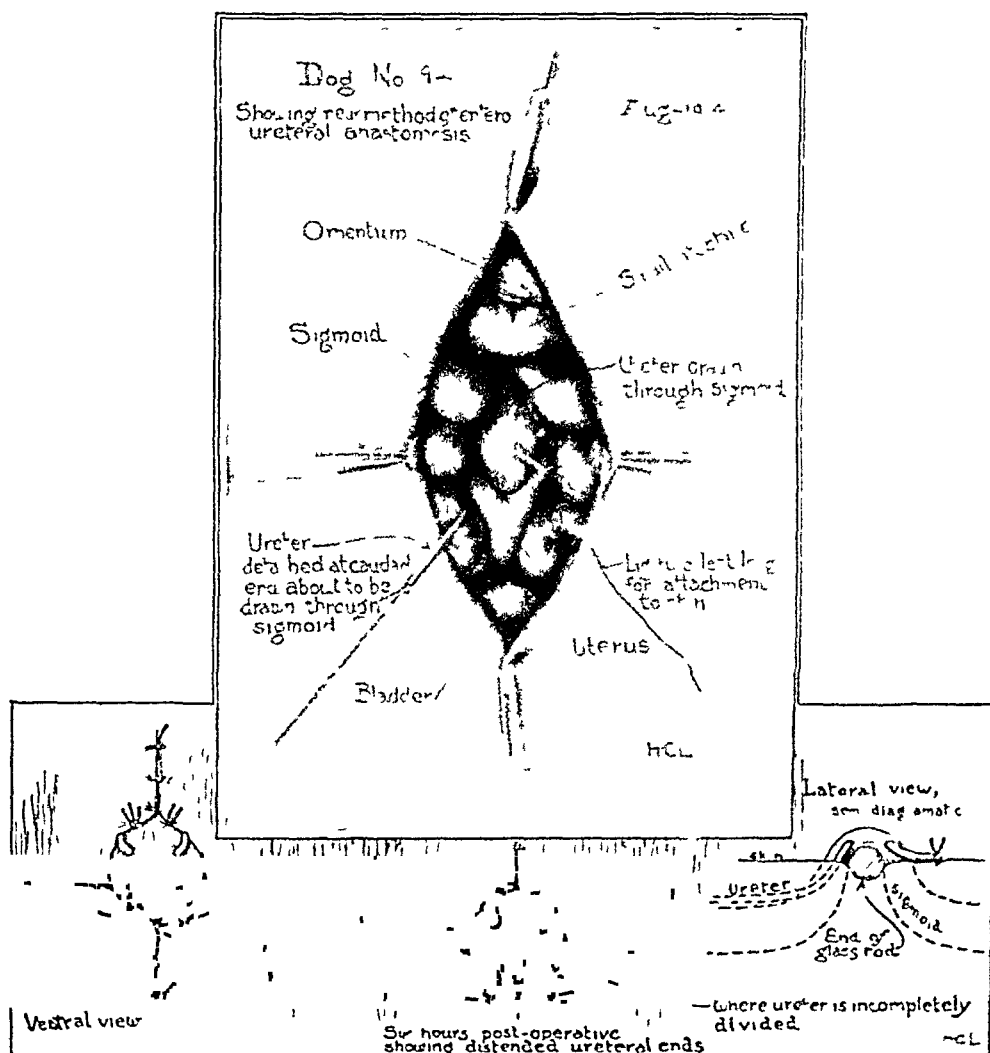


FIG. 1.—Technic of ureterosigmoidostomy

URETERO-ENTERIC ANASTOMOSIS

ture is fixed by a single suture. The wound is then closed about the sigmoid and the ureter. Six hours later the exposed ureter is incompletely cut and allowed to empty. It may be returned to the lumen of the intestine at any time thereafter, but it is well to retain it under control until its continued patency is assured. One or both ureters may be transplanted in this way within twenty minutes. An exposition of the rationale and an interpretation of the results of the operation is forthcoming.

STUDIES IN OBSCURE FORMS OF PROSTATIC OBSTRUCTION AND VESICAL ATONY*

BY BRANSFORD LEWIS, M D

OF ST. LOUIS, Mo

PROFESSOR OF GENITO URINARY SURGERY IN THE MEDICAL DEPARTMENT OF ST LOUIS UNIVERSITY

Importance of Etiology—A correct understanding of the exact causation of urinary obstruction and its congener, vesical atony, and the rationale of their interrelationship should have a most important bearing on the practical questions involved in such conditions, such as the determination of appropriate treatment, the success or failure prospective, in fact, the whole prognosis of the case

Curability—For instance, dependent on the question as to whether there is or is not such a condition as permanent vesical atony, may hinge the determination as to whether it is worth while or justifiable to operate for relief of an existing obstruction causing the atony It is claimed by some that no matter how long a bladder has stood widely dilated from chronic obstruction, it still has enough recuperative power to "come back," as pugilists say, and re-engage in the duty of expelling the vesical contents, provided the obstruction be effectually removed

Albarran, Young, Chetwood, Freyer and others seem in accord in this belief, and assert that incurable atony is practically never encountered

But there are others who hold there is such a condition as *essential atony*, irretrievably lost to all hope of recuperation, even though a recognized obstruction should be completely removed If this be true, the argument that it is useless in such cases to subject the patient to a radical operation for removal of obstruction is well founded; and operative endeavor is, under such circumstances, predestined to failure and should not be undertaken They further argue (Binney) that the hopelessness of such cases should be recognized in advance and included in the diagnosis and that measures should be based on such recognition

Certain authors believe that hopeless atony exists not only in consequence of obstruction or nerve degeneration but also in the absence of any obstructive factors, in other words, that permanent and irremediable atony may exist even where no cause for it, in the shape of an obstruction, can be found

* Read before American Urological Association, June 18, 1914

PROSTATIC OBSTRUCTION AND VESICAL ATONY

Unaccountable Cases—Byron Robinson (*Int Jour Surg*, December, 1909) remarked on the surprising frequency with which, in doing a thousand autopsies, one would run across dilated ureters and other physical evidences of damaging obstruction to the upper urinary tract and yet fail utterly to discover a cause for it. While no cause could be discovered, it was evident, he declared, that a potential factor must have existed.

Albarran and Nogués (*International Congr. of Urology*, Paris, 1908) reported two cases of atony of the bladder without known cause, in young men. These authors believed that the atony, when permanent, was due to senile degeneration of the bladder muscle from arteriosclerosis.¹ Asch (*Deutsch Med Woch*, 1909, p. 1293) reported the cases of four men and seven women, in whom he found atony with trabeculation, all obstructive and nervous causes being absent. This author attributed the condition to primary degeneration of the vesical muscles dependent on disease of the vesical nerves or of the ganglia of the vesical centres.

Under the title, "Atony of the Bladder without Obstruction or Signs of Organic Nervous Disease" (*ANNALS OF SURGERY*, November, 1910), Thomson Walker presented a striking report of twelve cases which formed for him an unsolved problem.

While this author realized that these cases deviated from the typical and traditional forms of prostatic obstruction and retention, he was not clear as to their etiology or nature. He excluded disease of the cord or nervous system by reason of the absence, for a sufficient length of time, of general symptoms of such, but was inclined to believe that they were explained by the existence of *some lesion of the sympathetic reflex centre*, which controls the functions of bladder and rectum, according to the theories of Goltz, Freusberg and Ewald (*Pflüger's Archiv*, Band 8, 9 and 63).

Various Theories of Causation—The French school, with some exceptions, has been inclined to the pessimistic belief, founded by Guyon, that urinary retention of the aged is due to degenerative processes (arteriosclerotic) involving not only the prostate but also the bladder wall and the kidneys. It stood as their most logical explanation of "prostatism sans prostate" (prostatism without hypertrophy). Though often denied, this claim seems still to have some advocates. Ware invokes it in discussing "Non-prostatic Urinary Retention

¹ Quoted from Binney, Transactions American Association Genito-Urinary Surgeons, 1911

of the Senile Bladder" (ANNALS OF SURGERY, January, 1911), but also utilizes the vesical degeneracy theories of Halle and Motz, of Ciechanowsky, and of Zuckerkandl, the latter of whom said ² "Senile changes or chronic destruction are capable of seriously damaging the bladder muscle in its function. There are incurable-forms of retention amongst the senile in whom no mechanical or nervous cause can be determined. Whether an atrophy or degenerative muscle is out of fix is not known."

Arguing that not obstruction at the neck but *incompetence of the vesical walls* is the explanation of such cases of retention, Ware applies the shotgun method and invokes all of the factors and influences available, ascribing the atony to "vascular, myogenic, neurogenic or infectious origin" and that in some cases all of these factors operate towards the same end."

Binney (*ibid*) supports the contention for essential incurable atony by reporting two cases of complete vesical retention that were unrelieved by prostatectomy.

He terms Ware's explanation, above quoted, vague and unsatisfactory, and attributes the detrusor weakness of such cases to diminished blood supply, promoted by arterosclerosis, on the one hand, and by atrophy from over-stretching of a poorly nourished musculature, on the other.

Lately comes Carraro, of Milan, Italy (*Revue Clinique d'Urologie*, March, 1914), who, supporting a suggestion of Motz and Arrese, declares his belief that the source of obstruction in these unaccountable obstruction cases lies in the presence of *prostatic adenomata*, which, though small in size, are effectively placed and lead to obstruction by impinging, in a manner scarcely perceptible, on the internal sphincter. This harmonizes with the views of Marion, who, reporting a number of cases of prostatism without hypertrophy, had been able to establish very small perivesical adenomata as the cause of the retention. Only the finger of the surgeon is capable of appreciating such minute adenomata, which escape detection by the cystoscope.

Divergence of Theories—The most striking impression one gets from reviewing the doctrines above quoted is of their wide divergence and lack of harmony. Certain of them place the blame on the detrusor system, which is deemed too weak to expel the vesical contents, while others ascribe the fault to the neck or sphincters, which are too strong, and in some mysterious or unrecognized way offer undue resistance,

² Handbuch der Urologie, 1904, vol 1, p 720

giving retention Whether from the one cause or the other, it is apparent that the happy "balance of power" that normally exists between the two systems, detrusor and sphincter, is upset, leaving urinary retention and, often, vesical atony in its wake That is the condition The question is, What is the causation?

Study of a number of cases of urinary retention of obscure origin impels the writer to register his dissatisfaction with the theories propounded and previously quoted as explaining these conditions and to call attention to some features of causation possibly overlooked

Author's Views—The writer is a partisan of the belief that urinary retention is occasioned by two causes only, namely, mechanical obstruction or nervous influence (interference with the nervous mechanism controlling urination) If we do not perceive which of the two is in play it is but an evidence of our human frailty in diagnosis Such cases must be studied in detail and analyzed critically

In the first place, there are many such cases in whom senility or arteriosclerosis can have no place whatever The writer has observed a number who have experienced difficulty in urination from their earliest infancy Their recollections have been connected with prolonged and troubled efforts at urination, impeded stream, straining, accompanied by the scoffing of boy companions who were more expeditious in their accomplishment of the act

CASE I—One such patient, E A H, who came in 1904, when twenty-nine years of age, was then found to have a widely dilated, atonic bladder, dilated ureters and kidneys, one of the latter a mere sack (hydronephrosis) that had to be opened up and drained to be restored to functional activity By perineal urethrotomy the life-long retention was demonstrated to be due to non-hypertrophic obstruction located at the vesical neck (contracture), and was only relieved after incisions had been made through a perineal opening, including electric incisions, opening up this offending region for the free escape of the urine The young man then made an excellent recovery, his vesical contractility and ability for free and easy urination were restored or, rather, established *for the first time*, so far as he could remember, after years of chronic retention and invalidism he became able to go back to active duties on his farm, which satisfactory condition has continued now for about nine and one-half years A letter recently received from the patient declared that his health was excellent and he was able to do hard work on the farm Wassermann test of his blood recently made was negative

Criticism of Theories Quoted—The claim (Asch and others) that the defect lies always in degeneration or incompetence of the *vesical walls* cannot be true, because in many instances evacuation of the bladder is prompt and complete on the introduction of a catheter, and this, too, in the presence of the so-called "atony without obstruction" The writer believes that, in the absence of the nervous factor, the form or nature of the obstructing factor is simply not recognized in such cases

The measures and means described as justifying the exclusion of physical obstruction do not seem beyond criticism or capable of justifying such conclusions Thus, Thomson Walker bases his exclusion of physical obstruction in his twelve cases on the following "First, no evidence of obstruction could be obtained The anterior urethra was examined in most of the cases with the urethroscope under air distention In all of them large metal sounds were passed (13-15-17) and the vesical orifice of the urethra was examined with the cystoscope The rectal surface of the prostate was examined with the finger and the vesical surface with the cystoscope No abnormality was detected by these methods"

The writer would say that personal experience would class these measures as insufficient to permit of the exclusion of certain forms of obstruction, particularly contracture of the neck This condition is not subject to detection or exclusion by palpation through the rectum nor cystoscopic view within the bladder, and, moreover, sounds of full size or even soft rubber catheters may pass without giving the slightest indication of such an obstruction, although it is really present and causing retention These facts were forcibly drawn to the writer's attention in a patient under his care during the past year

CASE II—B L, age thirty-nine This patient, also, had had slow and difficult urination from boyhood His earliest memories were connected with difficult urination Slow starting, slow running, if deferred for any time it would come only in drops The condition became so bad that the patient had resorted to the regular use of a catheter for the month or two previous to his coming

There were about twenty-four ounces of residual urine, marked atony, trabeculation, and one large diverticulum evidenced by cystoscopy It was readily determined that his obstruction was located at the vesical neck, probably due to prostatic contracture, notwithstanding the fact that none could be seen by cystoscope or felt by instruments He was tested out along these

lines, however, by the regular use of the Kollman dilator, reducing the residuum from twenty-four ounces to three ounces, where it was maintained only with difficulty and repeated stretching, up to 37 or 39 (French). Because these very considerable dilations did not secure lasting beneficial effects, it was thought by some who were interested in the case that the diagnosis must be erroneous, and that a prostatectomy was indicated. Convinced that a more radical procedure than dilating was justified by the partial failure of the latter, the writer made a perineal incision and introduced his finger into the vesical neck. He found a distinct ring of fibrous tissue whose obstructive influence could not further be denied. It was attested by others present. There was no enlargement and no indication for prostatectomy. Incisions were carefully made through the ring by probe-pointed bistoury, and a drain tube was left in. Even this was not sufficient to secure lasting relief from the obstruction and the procedure had to be repeated a week later, after which there was free natural evacuation.

In this case definite obstruction (contracture) was proved present after it had failed of detection by the several methods and means mentioned as having been relied on by Walker to exclude the existence of obstruction.

CASE III — *Obscure Contracture at Vesical Neck*. A F, age forty-five, carpenter, American, married. Referred by Dr F A Renner, Benld, Ill, January 27, 1911.

Past History — One attack of specific urethritis in 1908, lasting two or three months actively, with inflammatory complications in prostate and epididymis. Following this, an abscess of the prostate developed and broke into the urethra, which discharged pus actively for two weeks. No other venereal disease.

Present History — After the discontinuance of discharge from the abscess of the prostate, patient noticed some difficulty in urination. This became more marked and continued until the time of his first consultation.

Examination — Evidences of obstruction were very plain. There were straining, prolongation and marked efforts at evacuation, the incompleteness of which was shown in three or four ounces residual. Neither hypertrophy nor atrophy was observed by rectal palpation or cystoscopy, and no pathological lesion was discovered other than contracture at the vesical neck. This was demonstrated both by exclusion and by the fact that the deep urethral dilator became tight and painful when enlarged to 23 (French) within the prostatic urethra. No evidence of nervous or other organic disease was present and it was concluded that

the obstructive contracture followed the infective inflammation and abscess formation in the prostate

Treatment—Patient was given regular post-urethral dilatings, gradually increasing from 25 to 40 (French), followed each time by antiseptic irrigations. Under this treatment improvement was prompt, steady and sustained, rendering him capable of completely evacuating his bladder and resuming normal frequency and ability in this line.

CASE IV—*Congenital Contracture*—V S H, age thirty-two, salesman, December 21, 1909. Since infancy had frequent urination—five to eight times during the day and once at night. Stream was never full or free, but just leaked out and with interruptions. At age of fourteen had complete retention for one night. In infancy (mother's statement) a doctor passed a sound. Condition remained about the same until the age of nineteen, at which time he took some medicine (without an examination). Later, however, an attempt was made to pass sounds. Following this another doctor used sounds and Kollman dilator, which aided him in passing a stream for the first time. Was better until age of twenty-one when he acquired gonorrhœa and syphilis. Was treated three years for lues. Incidental effects of the gonorrhœa lasted until the time of his consultation—frequency and burning.

Examination—Cystoscopy revealed a tender and diffusely inflamed bladder. Catheterization of ureters gave normal urine from the left side but that from the right contained many bacteria (colon) and epithelial cells. No pus.

Treatment—Recovery followed deep dilatings and posterior irrigations. Dilatings for six months advised.

It is probable that contracture is the "potential factor" that is either overlooked in some cases or is so elusive that it is difficult of detection save by direct palpation through the opened bladder or urethra. In default of such open palpation, in doubtful cases, the therapeutic test should be applied, namely, Kollman deep urethral dilatings regularly and progressively administered while the effect on the residual urine and ease of urination are being watched and compared. Some of the most modern posterior urethroscopes (McCarthy's and Buerger's), as well as the retrospective cystoscope, give an excellent view of the vesical neck and internal sphincter and render material assistance in solving the local diagnosis of such conditions.

Minute Adenomata.—The bearing of minute adenomata on such obscure obstructions, as suggested by Carraro, will have to be further studied before the claims of its author can be conceded. The fact that

many such cases are relieved either by dilating or electro-incisions, without the removal of tissue, would seem to militate against the frequency or importance of this as a causative factor

It seems likewise improper to admit the claim that the failure of a prostatectomy to relieve retention is evidence of unreliable atony. Not infrequently after prostatectomy (particularly the perineal) conditions are not altogether satisfactory for a time. The irregular conditions left after the enucleation have to be smoothed out, and the patient often has to learn over again the act of urinating—which may have been so long in abeyance that he has forgotten it. Surely, the “class in urination” of the late Dr. Sam Alexander is not already forgotten, in which a number of his prostatectomy cases were daily lined up for instruction and rehearsal in starting and stopping the urinary stream.

It has been the habit of the writer not only to utilize instruction of this sort in certain hesitating convalescent prostatitics, but also to make use, where demanded, of a sound or Kollman dilator for favoring control and recovery.

Bearing on Spinal Syphilis—Even where there is no physical obstruction at the neck there may be a potential one—as that occurring in connection with tabes or other form of spinal lesion. The retention and extreme atony in these cases are due to the relative obstruction offered by the vesical sphincters, which are simply incapable of being opened up before the crowding urine, impelled by the normal amount of detrusor pressure. The detrusors may be as strong as ever, but they have a *relative* obstruction to deal with now in the meat and therefore *resisting sphincters*.

Impending Change of Views—In view of the flood of light being shed on this subject by the far-reaching Wassermann tests, it is probable that current views are destined to undergo much change in the near future, if they have not changed already.

Formerly, until the grosser evidences of tabes or spinal syphilis appeared, in the shape of impeded gait, or vision, ataxic pains, etc., it was difficult to detect such a cause as tabes behind a crippled bladder, the subject of chronic retention and atony. Now we have the Wassermann tests, both blood and spinal fluid, and the harvest is something surprising, the veil is being drawn from many cases that have proved most puzzling. Within the past two years we have had a number of cases in which men of middle or advanced life, sedate and settled, with grown children, so far past the period of youthful indiscretions that they have almost forgotten them, have developed urinary obstruction and its sequelæ of urinary frequency, retention, vesical dilatation, and

atony Some have become the objects of various kinds of surgical treatments or assaults, including, perhaps, removal of the prostate, all without benefit to the retention, and finally, on examining and analyzing the cases closely, we have found them to be simply presenting the earliest evidences of spinal syphilis hitherto unrecognized by the patient or his physicians, which diagnosis has been confirmed by Wassermann blood or spinal serum tests Such a revelation has proved not only astonishing to the patients, as an immediate result, but far reaching and vastly important from the therapeutic stand-point

Adopting the valued experiences and teachings of Swift and Ellis, we have followed up this diagnosis with intraspinal injections of salvarsanized serum, and in certain cases with equally as striking and gratifying results

Illustrating the insidiousness and obscurity of such causation, the following cases are briefly mentioned

CASE V—C E C, age fifty-one, American, married Referred by Dr W B Yost, March 11, 1911

Family History—No family history indicative of lues or other affections that would have a bearing on the case

Past History—No history of gonorrhœa, lues, sore or other condition pointing toward a specific infection

Present History—Had never noticed any disturbance directly connected with genito-urinary tract Four months previous to his first consultation, he had consulted Dr Yost on account of slight fulness and distress in abdomen, also indigestion of moderate severity In the course of his examination the doctor catheterized the patient and to his astonishment drew off 160 ounces of urine This relieved the feeling of heaviness and fulness in the abdomen immediately On close questioning it developed that he had some retardation in beginning and completing urination Following this, patient catheterized himself three times daily for three months without definite improvement, at which time he came to me

Examination—Testing out the findings of the condition reported, we had the patient urinate all he could voluntarily, amounting to 14½ ounces, after which a soft rubber catheter was easily passed, drawing off 60 ounces of clear, uninfected urine Examination by all methods, including cystoscopy, failed to disclose any prostatic hypertrophy or contracture Neither were there any evidences of a spinal lesion

Treatment—Patient was placed on regular deep urethral dilatings, going rapidly to 40 and 45 (French) His ability to urinate improved very considerably and then he stopped treat-

ment. Recently, at my personal request, he submitted to the taking of blood for a Wassermann. This proved suspiciously positive, another specimen a week or two later showed plainly two plus positive. Patient would not submit to a neurological examination, but, during the time he was under our care, no indication of ataxia or other spinal lesion was noticed.

CASE VI—L J A, age forty-six, American, married

Family History—No family history indicative of lues, paralysis or nervous disease

Past History—When about eighteen years of age patient had gonorrhœa lasting about two years, recovery. No other venereal disease. No history of sore, headaches, general eruption or local lesions. Attack of "mountain fever" twenty-five years ago.

Present History—Two years ago began noticing difficulty in urination, requiring longer time and straining to evacuate. February, 1913, became unable to control it, coming involuntarily, occasionally. Some difficulty in walking was observed at the same time and sexual ability and desire became lost. Consulted several physicians, who gave various diagnoses and treatments.

Examination—Examination showed no enlargement of the prostate, stricture or other obstruction at the neck of the bladder, in spite of twenty-three ounces of residual. Neurological examination disclosed complete absence of knee jerks, hesitancy in speech, marked tremors of facial muscles, sensation of pain greatly diminished in lower limbs and a very unstable station. Argyll-Robertson pupils.

Treatment—Patient was placed on deep urethral dilatations and irrigations and residual was reduced to one-half ounce (February 11). Wassermann of blood was four plus positive. Was given intraspinal injection of neosalvarsan (per Swift-Ellis method). Following this there was improvement in eyesight, limbs felt stronger, and station was more stable. Two weeks later a second intraspinal injection was given. Spinal fluid gave a four plus Wassermann.

One month later examination of patient was made with following results. Condition of pupils unchanged. Facial muscles equal, no deviation of tongue. No intrinsic or extrinsic tremors. Abdominal and cremasteric reflexes sluggish. Knee jerks present but sluggish on both sides. Slight Babinski on both sides. Station fair, enunciation improved. Marked improvement in sexual ability and desire. Residual reduced from 23 ounces down to 1 or sometimes 2 ounces. General condition much better.

CASE VII—A C H, age forty-five, American, married, farmer. Referred by Dr E J Burch, January 24, 1911.

Family History—Negative

Present History—From earliest childhood patient had had trouble in urination, required a long time, stream was slow and difficult, accompanied with much straining. Denied all venereal disease. Following a rupture in 1909 had been catheterized and a pint of residual drawn off. Bladder then became irritated with frequent urination, pain and other evidences of infection. Wore retained catheter for a year and a half with some relief. At the time of consultation had to urinate every two hours both day and night.

Examination—The stream was slow and retarded, dropping indolently downward. Soft rubber catheter was passed easily and 10 ounces of cloudy, infected (colon bacilli) urine drawn off. There was no enlargement of the prostate or contracture at the vesical neck, no organic or spasmodic stricture. Ureteral catheterization gave purulent, infected urine from both kidneys.

Treatment—Dilatations and tonic vesical irrigations were given and served well to restore to a striking degree the ability of the patient to empty the bladder and return to work.

Recent Wassermann on this patient gave a feebly plus positive, but we have had no opportunity for a neurological examination. This had been considered as one of the unaccountable cases of retention until the revelation made by the Wassermann blood-test placed it in the category of luetic spinal effects.

CASE VIII—P. R., age fifty, American, bookkeeper, married. Consultation April 18, 1907.

Past History—Sore on penis 27 years previous. Following this alopecia and sore throat. Five attacks of urethritis during last 30 years.

Present History—Following the gradual development of a contracted stream, his surgeon diagnosed "stricture," and cut internally in 1898. Patient complained of great pressure when the bladder filled and urine escaped involuntarily. No undue frequency of urination. Stated he had occasional severe pains in his legs, almost causing him to fall.

Examination—Large soft rubber catheter was passed easily and seven ounces of cloudy, bad-smelling (acid) urine drawn off. Cystoscopy revealed nothing except a somewhat funnel-shaped internal meatus. Dr. W. W. Graves made a neurological examination of the patient and reported greatly disturbed sensation all over the body, slight inequality of tendon reflexes, unequal pinhead pupils, deficient mentality. He stated that there was little doubt that the patient had had a luetic infection at one time.

CASE IX—*Mixed etiology*. A case in which both spinal lues and contracture may be factors is the following.

PROSTATIC OBSTRUCTION AND VESICAL ATONY

F C, age forty-six, American, salesman, married, October 26, 1912

Past History—Gonorrhoea, 1886, 1887, after drinking a great deal of liquor, had retention of urine and had to be catheterized. Following this had sounds passed, which treatment was repeated many times at intervals, once with divulsion and internal urethrotomy.

Present History—Now has great difficulty in urinating. Says he passes catheter easily, but when he attempts to urinate something seems to drop down and obstruct the passageway. Says he has about one pint residual.

Examination—Cystoscopy showed moderate congestion of bladder mucosa but nothing to account for obstruction. Soft catheter (18 French) introduced easily. Buerger endoscope showed marked ring of mucosa located at prostatic apex. Behind this was a deep pocket holding approximately two to three drachms with the verumontanum appearing anteriorly on the inferior wall. Posterior to this was the internal orifice with internal sphincter.

Treatment—Perineal urethrotomy confirmed the ring of contracture and cavity. Incision through obstruction until good entrance was obtained. This was followed by deep urethral dilations. Result: Complete emptying of bladder with exception of $\frac{1}{4}$ to $\frac{1}{2}$ ounce. Stream good. Wassermann, February 21, 1914, was four plus positive.

CASE X—*Obstruction Consequent on Hereditary Syphilis.* The influence of hereditary lues is markedly shown in the following case.

Wm J H, age nineteen, American, single.

Family History—From patient's statement family history negative. Later developments showed a strong positive Wassermann in father.

Past History—Denied all venereal disease. Beginning about the age of ten patient noticed some difficulty in urinating—took him a long time and required much straining and stream had little force. Flow was irregular. Had some pain in connection with urination. Was not relieved after the act, still had desire. Felt nervous.

Present History—Three years ago, while straining at stool was seized with severe pain in glans penis and scrotum, lasting one-half minute. One month later had a second attack, followed in a week by a third, with pain in bladder, rectum, penis and lack of control of urine. Consulted six or eight different doctors who made various diagnoses, *e g*, "irritation of bladder," "ner-

vous lack of control," "acid urine," "strictures," "hypertrophied prostate," etc. Had "suprapubic prostatectomy" and opening has never healed. Had no recurrence of above mentioned pains until two months ago, when sensation of scalding in bladder began. Urination was difficult. Most of urine came through wound.

Examination—General condition bad, run down, nervous. Suprapubic wound leaking. Prostate and vesicles palpable. Three drops mucopus on massage. No enlargement. Cystoscopy showed opening of fistula on superior wall. Small papilloma at side (granulation tissue). Buerger endoscope showed contracture at vesical neck. Five ounces residual.

Neurological examination. Facial expression dull, pupils widely dilated, left larger than right, both irregular, react to light and accommodation. Station fair. Knee jerk absent on left, normal on right. Sensation to pain markedly diminished below knees and on inner surface of thighs. Wassermann four plus positive.

Treatment—Patient was given regular deep urethral dilations and irrigations. Dilating was carried up to forty (French). Was given two injections of neosalvarsan, followed by intraspinal injection per Swift-Ellis method and four injections of salvarsan by intraspinal method. Spinal fluid four plus until last injection, at which time it was two plus. For last two months patient has had no residual whatever.

Until it was suspected as the underlying cause of the urinary retention, and proved by laboratory tests, confirmed by clinical research, none of these patients or their physicians had the slightest suspicion that syphilis was a factor or had ever been present with them. The father of the boy (Case X) was only suspected because we deemed the syphilis of the son hereditary. He (the father) showed a four plus Wassermann, notwithstanding that he declared he had never had any manifestations of the disease. The son had never had any venereal disease. So the hiatus between syphilis and the mysterious vesical malady of the son, according to ordinary methods of computation, was a long one, so long, indeed, that it might never have been thought of had he not acted as nurse for his little nephew one day when visiting our office, and the child showed evidences of hereditary syphilis in its teeth and nares. This put us on the trail of family investigation and revealed syphilis in the child, its mother, its grandfather and its uncle, the boy who had been the interesting subject of so many medical and surgical vicissitudes, as related.

Such cases of concealed syphilis are usually "treated" for the more

usual forms of prostatic obstruction, and they are indeed fortunate if they escape an attack on their prostates long enough for their real condition to be found out

Advantages of Early Recognition—Fortunately, too, a correct diagnosis leads not only to the avoidance of measures entirely inappropriate, but impels one to the modern measures that have proven so efficient in the earlier periods of nerve syphilis, namely, the prompt and repeated use of salvarsan or neosalvarsan, both in the veins and the spinal canal, backed up by the iodides and the intramuscular injection of mercury. Locally, also, much can be done for improving the power of the bladder to empty itself. Repeated overstretching of the vesical sphincters, just as with contracture, etc., promotes ease of urination and reduces the residuum. Intravesical irrigations are used in connection with these measures.

Retention without Obstruction—Whether there are cases of chronic retention and atony absolutely free from all kinds of obstruction or nerve lesions, it is hard to say. Before the developments of the Wassermann tests the writer was inclined to believe there were such. Now it seems advisable to again subject such cases to the scrutinizing research of Wassermann tests⁴

Incoordinative Retention—As mentioned elsewhere⁵ the writer believes that the syphilitic spinal degeneration produces an incoordinative retention because of *relative* sphincteric obstruction. A similar relative sphincteric obstruction is produced in the absence of syphilis, through habits of postponement of urination, the tardy relief producing obtunded sensibility of vesical nerves that finally results in dilated and atonic bladder, incomplete evacuation, chronic retention, and possibly the secondary effect of overflow-incontinence. The writer has recorded a case of spina bifida with such sequence. The patient, an adult male, failed to wear a protector over the spinal protrusion, which was thus rendered subject to jolts and contusions in his earlier life that, as explained in consultation by Dr W W Graves, resulted in a subacute neuritis involving the vesicospinal centre and obtunding the nerve filaments at the periphery (the vesical neck). Thereafter desire to urinate was not aroused promptly on the filling of the bladder, so that frequent over-stretching ensued. Following this came atony, further tolerance, and chronic retention, with total inability for voluntary urination. No

⁴ In several of our cases of urinary obstruction, formerly held obscure or unaccountable, subsequent investigation has shown the cause to be syphilis unrecognized up to that time

⁵ Keen's Surgery, vol 1v, p 300 *Ibid*, p 301

other factor for developing the retention could be discovered in this case

CONCLUSIONS —1 The exact causation of urinary retention should be sought for in all cases before adopting a plan of treatment

2 It should always be found in one of two factors, viz, (a) physical obstruction of some kind, or (b) disturbance of the nervous mechanism controlling urination

3 There is no such thing as "unaccountable" atony or urinary retention, such a term represents an incomplete diagnosis

4 There is no such thing as "incurable atony" except when it is caused by some nerve-degenerative process (tabes, etc) that precludes restoration of the expulsive power, and it is unjustifiable in the most of these cases

5 Even when the retention and atony are caused by nerve degeneration much can be done in the way of treatment, both locally and internally, to facilitate urination and improve the conditions prevailing

6 Where the cause is a physical obstruction, its complete removal paves the way to restoration of the expulsive power

7 The most frequent and important of the obscure, unrecognized causes of obstruction are (a) ill-defined contracture at the vesical neck (demonstrable sometimes only by palpation through the opened bladder or urethra), (b) unrecognized syphilis, acquired or hereditary, affecting the spinal centres

8 Such conditions are by no means confined to adult life, and should be looked for and recognized at any age, from infancy up, diagnosed and treated in accordance with the refined diagnosis always demanded by cases of urinary obstruction

9 Syphilis is a surprisingly frequent cause of such conditions. Lack of syphilitic history or general nerve symptoms, in obscure cases, should not preclude investigation by means of a Wassermann blood-test, and if this proves doubtful, a Wassermann test of the spinal fluid should be made as well

10 The supreme value of early recognition and differentiation of such cases appears in the opportunity it offers of affording appropriate treatment before the case has assumed the hopeless phases that preclude reclamation or benefit

A final, but too late, recognition is but poor solace for a lifetime of suffering due to delinquencies in diagnosis

ON THE LYMPHATIC DRAINAGE OF THE PERITONEAL SAC

BY WILLIAM CAVAN WOOLSEY, M D

OF BROOKLYN, N Y

(From the Department of Surgical Pathology of the College of Physicians and Surgeons of New York)

THE lymphatic drainage lines from the subdiaphragmatic viscera are factors of which we have some definite knowledge. The subperitoneal, submucous and interlobular visceral lymph capillaries drain through collecting radicles into definite groups of neighboring lymph-nodes and from these nodes efferent vessels eventually empty into the lumbar trunks, receptaculum or thoracic duct.

Clinically, the anatomical relation that definite groups of nodes bear to definite organs and areas and to each other enters into the pathological conception of all infections of the abdominal cavity and visceral malignancy. Metastatic deposits in tissue distant from a primary carcinomatous focus are observations too common to arouse comment. Malignant invasion of the liver from the breast by means of a retrograde permeation of the epigastric or costoxiphoid lymphatic channels has long prompted surgeons to adopt the routine removal of these avenues of extension in operations for carcinoma of the breast. Deaver and Pfeiffer (*A J M Science*, 1912) consider clinically the important relation between infections of the gall-bladder and pancreatitis and the lymphatic intercommunication of gall-bladder with duodenum and pancreas. Infections of the appendix may travel far indeed when the spread of its outgoing lymph-stream may be known to reach the upper abdomen.

Sweet and Stewart (*Surg, Gynec, and Obst*, vol xviii, 4) offer considerable evidence that the ureteral submucous and subperitoneal lymph-channels are the avenues of extension for infectious processes from the bladder to the kidney and not the ureteral lumen.

On the other hand, the peritoneal sac, so far as we know, having but a limited lymphatic function to perform under normal circumstances, seems to possess distinct and extremely active potential lymphatic absorption lines. These appear to be independent of those of the visceral system and not confined to the central tendon of the diaphragm, as Muscatello taught in 1895, but are present over the whole surface of the dome of the diaphragm.

Poirier and Cuneo have described the diaphragmatic lymphatics as forming glandular groups on the convex or pleural surface of the diaphragm, arranged as a few small nodes posteriorly between the crura, two small middle groups placed laterally and several anterior groups including the costoxiphoid glands of Sappey. These latter anterior groups receive afferents from the liver through the falciform ligament and send efferents to the retrosternal chain of lymphoid tissue. The hepatic radicles from the falciform ligament of the liver unite in a short trunk at the ensiform to penetrate the diaphragm and empty into the costoxiphoid nodes.

From the internal mammary chain efferent lymphatics join the thoracic duct at or near the subclavian vein or enter the subclavian independently. Efferent channels from the posterior and lateral diaphragmatic groups are said to drain posteriorly into the juxta-aortic nodes or direct into the duct. Afferent vessels to these diaphragmatic nodes are not mentioned. The problem of investigating lymphatic drainage from the peritoneal sac has been studied by Von Recklinghausen, Poirier and Cuneo, MacCallum, Muscatello and many others and has been carried on by means of the injection of foreign agents into the peritoneum and histologic study of the diaphragm.

Prominent among the questions that arise in a consideration of this subject are

- 1 The physical integrity of the mesothelium covering the abdominal aspect of the diaphragm, as to the presence or absence of openings of sufficient size to be called stomata (Von Recklinghausen, 1865)

- 2 The exact manner and path of absorption from the peritoneal cavity of injected foreign agents

- 3 The existence of a direct lymphatic absorption as opposed to or in conjunction with a hæmatogenous absorption

- 4 The activity of the diaphragmatic lymphatics in assuming the major rôle in such absorption

Question 1. No observer since Von Recklinghausen has been able to offer any satisfactory evidence of openings in the diaphragmatic peritoneum, by virtue of which the peritoneal sac becomes a unit with the lymphatic system. MacCallum (*Johns Hopkins B*, vol 14, 146) reports a most complete histologic study of the diaphragmatic peritoneum and finds no evidence of such stomata. After repeated and careful study of the flat-celled mosaic which covers the diaphragm the writer wishes to confirm this report. Tangential, protargol impregnated sections (Fig 1) show no break in the perfect approximation of cell to cell, of sufficient size to be in any sense considered as a mouth or stoma

Furthermore, it seems to the writer of little pathological consequence whether it is generally believed that such openings do exist or whether, as occurs in the metabolism of the vegetable cell, certain foreign substances are abundantly able to migrate intra- and intercellularly by means of a process of cell inclusion and extrusion described by Pfeiffer (*Physiology of Plants*, vol 1, p 3) as the translocation of foreign agents by streaming movements of the cell protoplasm

Question 2 Muscatello (Virchow's *Archives*), 1895, and Buxton and Torrey (*J Med Research*, vol xv, No 1, July, 1906) made the remarkable observations that finely divided particles of carmine, carbon, chicken blood corpuscles and dead micro-organisms were transported from the peritoneal cavity of animals to the superior retrosternal lymph-nodes at the junction of the first rib and the sternum in five minutes. The writer has conducted similar experiments fifty or more times and has found that not only does India ink and fine lampblack reach these distant lymph-nodes (Fig 2) from the pelvic fossa with this remarkable speed, but in some instances reaches the bronchial lymph-nodes as well. There seems to be no doubt, therefore, that there exists a prompt lymphatic absorption from the peritoneal sac by certain lymph-vessels which carry the absorbed material as far as the superior retrosternal lymph-nodes.

The path followed by this absorbed material in migrating from the pelvic fossa to the superior retrosternal lymph-nodes is more difficult to demonstrate. MacCallum's study (*vide supra*) was concentrated upon the double-layered cellular membrane constituting the diaphragmatic mesothelium and the lymphatic wall, through which the absorbed agents must pass in order to leave the peritoneal sac and enter the lymph stream. His conclusions were, that phagocytosis played the primary part in this transmigration and that a certain small percentage of the material might pass free through a loosely constructed intercellular substance into the lymphatic lacunæ. With these conclusions of MacCallum in mind, namely, the predominance of a phagocytic agency in the emigration of such agents as carbon through the peritoneum covering the diaphragm, and those of Muscatello and Buxton and Torrey, relative to the remarkably rapid dissemination of such foreign agents to the retrosternal lymph-nodes, the writer proceeded to study not only the peritoneal mesothelium but the paths taken by the carbon after it had penetrated the peritoneum, at all possible points from the peritoneum to the retrosternal glands. From 3 to 5 cc of a suspension of artist's special moist lampblack in salt solution were injected into the lowest point possible of the peritoneal sac of guinea-pigs. After vary-

ing periods of time the animals were killed and the diaphragm, superior retrosternal lymph-nodes, mesenteric nodes, and portions of the pelvic and abdominal parietal peritoneum were removed

The microscopic investigations included the study of tangential sections of the abdominal surface of the diaphragm at various points of the muscular edge and tendinous centre, similar sections of the pleural surface of the diaphragm, and cross-sections from each of several areas. From these sections, photomicrographs are selected and presented herewith to illustrate the conditions found. Examination of the unsectioned peritoneal surface of the diaphragm with binoculars shows the particles of carbon to be gathered in smudges over its entire surface and attempts to either wash it off or otherwise remove it demonstrate its firm adhesion to the glistening peritoneal surface. Tangential celloidin sections of this abdominal peritoneum show, as MacCallum says, a number of carbon particles within leucocytes, but in periods of less than ten minutes after injection, the greatest quantity of carbon by far is to be seen free within the peritoneal cells and in the lacunæ. At points other than where the lacunæ appear (Fig 3), the carbon, having penetrated the peritoneal mesothelium, is seen in the endomysium among the muscle fibres. In these endomysial trabeculæ the lymphatics of the diaphragm are known to run and in section they are seen to divide and join again, forming a network of carbon-containing tissue tracts over the whole diaphragmatic musculature.

In cross-section at any point in the diaphragm the carbon is seen to (Fig 4) penetrate the peritoneal mesothelium and follow the endomysial channels from one side of the diaphragm to the other. Tangential sections of the pleural surface of the diaphragm present here and there (Fig 5) large lymphatic radicles running just under the pleural mesothelium filled with carbon particles.

With the assistance of Prof. Adam Miller of the Department of Anatomy, the writer next attempted to inject the lymphatic radicles of the diaphragm with India ink by means of a fine glass cannula used by him in his vascular injections of the chick embryo. The ink when deposited under the mesothelium of the abdominal side of the diaphragm always followed fine parallel lines corresponding to the long axes of the tendinous and muscular fibres. When these lines are compared with the tangential sections (Fig 3) they are seen to be the endomysial tracts which have been shown microscopically as the paths taken by the absorbed carbon.

After these injections under the peritoneal surface of the diaphragm a few distinct beaded lymphatic radicles appear on the pleural surface,

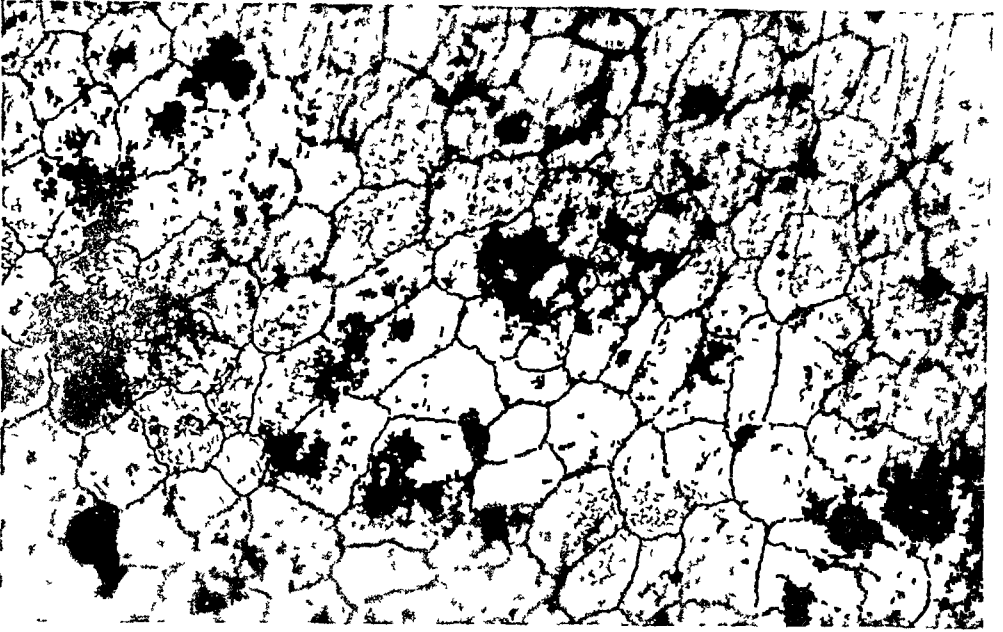


FIG 1 —Tangential protargol impregnated section of diaphragm after injection of 3 c c of carbon
No stomata, carbon in smudges (Photo 450 diams)



FIG 2 —Superior retrosternal lymph-node guinea-pig five minutes after injection of 3 c c of carbon
in pelvic fossa Carbon in afferent sinuses (Photo 375 diams)

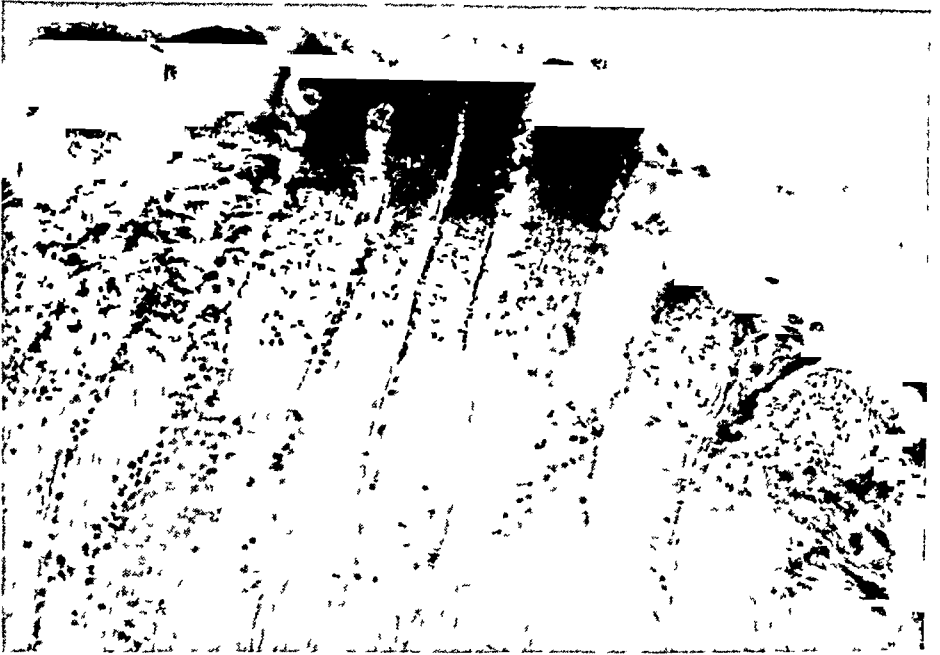


FIG 3 —Tangential protargol impregnated section of peritoneal surface of diaphragm showing carbon in endomysial channels

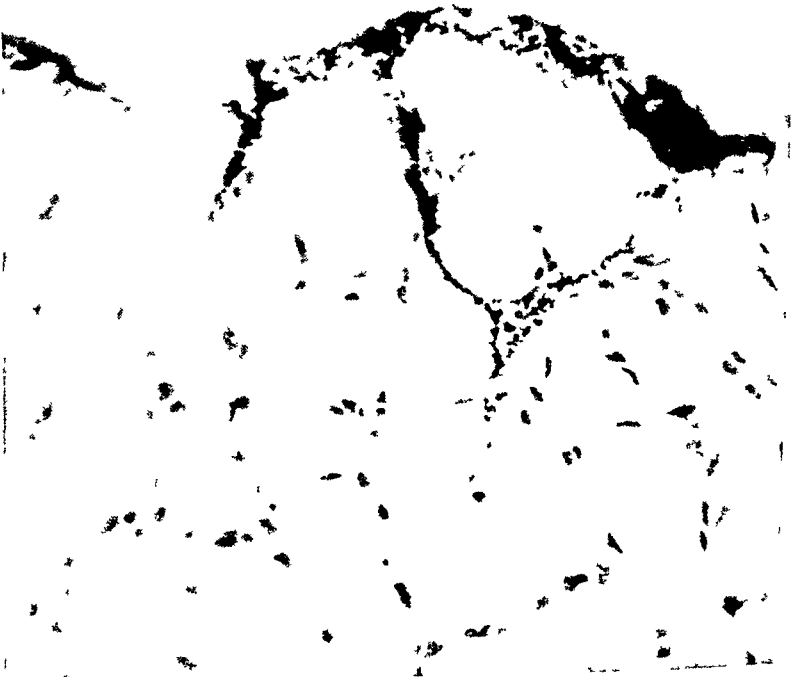


FIG 4 —Cross section of diaphragm showing carbon five minutes after injection penetrating well into endomysial channels from peritoneal surface (Photo 400 diams)

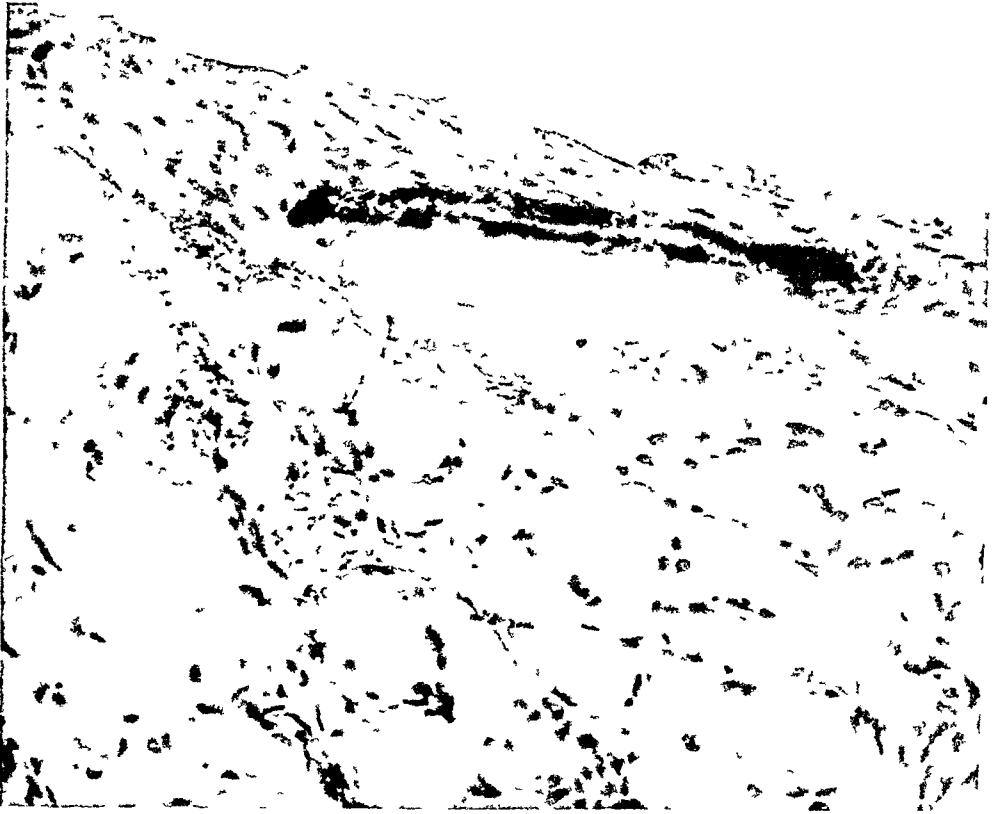


FIG 5 —Cross section pleural surface of diaphragm showing lymphatic filled with carbon five minutes after injection and carbon collecting in endomyrial channels near pleural surface (Photo 300 diams)

coursing from the muscular and tendinous portions to the ensiform attachment. Similar radicles rapidly carried the ink from the region of the liver up through the falciform and to the costoxiphoid glands of Sappey. Attempted retrograde injection of the retrosternal lymphatic chain from the superior retrosternal glands to the ensiform and diaphragm failed apparently on account of valves in the lymph-vessels.

Question 3. The observations made by Muscatello and Buxton and Torrey already referred to, verified and amplified by the writer, made practically positive the belief that a direct lymphatic absorption does take place from the peritoneal sac. Recently the question of hæmatogenous *versus* lymphatic absorption from the peritoneal sac has been brought forward in a report by Dandy and Rountree, *ANNALS OF SURGERY*, April, 1914, in which a general denial of any considerable lymphatic absorption was made. Without occupying space by going into details as to possible physico-chemical errors consequent upon drawing conclusions from a comparative test of the time of appearance of sulphone-phthalein in the urine and in the thoracic duct, the following points may be noted:

Wells and Johnstone (*J of Infec Diseases*, 1907, vol. 14) have successfully attempted to show that bacteria do not pass into the blood-vessels of the general peritoneum but reach the blood wholly by way of the lymphatic vessels. In order to approach the conditions active where fluids are to be absorbed from the peritoneal sac, the writer injected with the same technic used for carbon, 3 c.c. of a 0.1 per cent solution of trypan blue. The animal was killed immediately and in the short space of time necessary to remove the superior retrosternal lymph-nodes, namely, two minutes, these were found a deep blue color.

Time had not elapsed for any general diffusion of the dye and we feel justified in concluding that it had travelled from the pelvic fossa by the same channels as the absorbed carbon.

Question 4. In all the carbon and trypan blue experiments various specimens of tissue that had been directly bathed in the injected solutions, namely, the parietal peritoneum other than that of the diaphragm, the visceral peritoneum and the mesenteric glands were investigated microscopically for evidence of absorption at these points and none was found. From the peritoneal sac, therefore, solid particles of carbon, living and dead microorganisms, chicken blood-corpuscles and saline solutions of trypan blue are seen to be absorbed definitely by lymphatics which, having their origin in the diaphragm, stream past the superior retrosternal lymph-nodes and in such short space of time as

to prove this absorptive path one of definite and prompt activity whether a coincident hæmatogenous absorption takes place or not

Carbon injected under the visceral peritoneum regularly followed definite lines to definite neighboring lymph-nodes and in one instance, where the cæcum was especially infiltrated, a gland taken from the region of the duodenal curve near the pancreatic head was found full of carbon

Incidentally the rapidity with which fluids are removed from the peritoneal sac under normal conditions of circulation was noted in the first place by the remarkably small residue of 10 c c of carbon solution that could be found in the peritoneal sac twenty-five minutes after injection, and in the second place by observation made in the rabbit, when two drachms of the animal's blood was allowed to flow from a mesenteric vein into the pelvic fossa and, without further damage to the peritoneum, the abdomen closed. In twenty-four hours all that could be found of the two drachms of blood was a small speck of pinkish fibrin, which consisted microscopically of a few leucocytes and a few strands of hæmoglobin stained fibrin

Conclusions—1 Absorption of certain solid foreign material injected into the peritoneal sac occurs with marked rapidity, first by a process of translocation through the cells of the diaphragmatic mesothelium and later through the agency of leucocytes

2 That such solid foreign material having passed the peritoneal mesothelium is conveyed through the endomysial tracts throughout the diaphragmatic musculature to the lymphatic radicles on the pleural surface of the diaphragm, from these through the various diaphragmatic gland groups to the costoxiphoid glands of Sappey, and from thence through the retrosternal chain of lymphoid tissue to the subclavian vein or thoracic duct

3 That certain fluids injected into the peritoneal sac follow the same lymphatic absorption lines, whether they coincidentally enter the blood stream directly or not

4 That the tissues of the diaphragm take a distinctly active part in absorption from the peritoneal sac and that other areas of parietal peritoneum functionate little if any in the lymphatic absorptive process

5 That the post-operative postural treatment of pelvic peritonitis as advocated by Fowler has definite pathological foundation

The author's gratitude is here recorded, for the friendship that prompted the assistance given him by Prof W C Clark, Adam Miller and Dr John C McWhorter

THE PREVENTION OF POST-OPERATIVE ADHESIONS IN THE PERITONEAL CAVITY*

BY JOSHUA EDWIN SWEET, M D , R H CHANEY, M D

AND

H L WILLSON, M D

OF PHILADELPHIA

(From the Laboratory of Surgical Research, University of Pennsylvania)

THE problem of checking or limiting intestinal adhesions following abdominal section is of such great practical importance that it has stimulated many suggestions for solution. It was considered advisable to undertake an experimental comparative test of some of these methods which have been advocated. The work was carried out upon dogs which were at the time of operation under complete surgical anæsthesia with ether, and which received both before and after operation the best possible care. In all operative work the strictest methods of asepsis were employed, such as are used in the operating rooms of modern hospitals.

The first work, done in a measure for a control series, was simple intestinal anastomosis. In these cases the abdomen was opened by midline incision about three inches in length, extending upward from the umbilicus. The gut was drawn out through the wound, protected by gauze pads, a section removed, and an end-to-end anastomosis performed. The gut was then returned to the abdominal cavity and the wound closed by the layer method. In all the following work the same type of incision was used, and the same method of closing the wound.

Two cases of simple end-to-end anastomoses were done. These animals were killed by gas at the end of six and eight weeks respectively. In both cases the abdomen was free from adhesions, the gut normal and no signs of peritonitis were present.

The next experiment in the series was performed to see what the effect of covering the operative area with an attached portion of omentum would be. In these instances two end-to-end anastomoses were performed on the same intestine, the first being left free without covering, the second being covered with the free border of the omentum. The omentum was carefully wrapped over the site of operation and held in position by a couple of silk stitches. This dog was killed and

* Read before the Philadelphia Academy of Surgery, November 2, 1914

autopsied three weeks after the operation. The abdominal cavity was free from exudate or any indication of peritonitis, and free of adhesions, save for the point at which the omentum had been attached to the site of anastomosis at the time of operation.

The next two dogs operated upon were treated in a similar manner with the intention of observing the effect of free omental and mesenteric grafts in the prevention of adhesions. In all of these cases three anastomoses were made—one left free without covering, one covered with a free piece of omentum, while the last was covered with a free piece of mesentery.

The strip of omentum was taken from the lower free border—the raw surface of the omentum being closed with a fine silk ligature. The strip of mesentery was taken from the redundant mesentery left after the removal of a section of the bowel. The grafts were held in place over the points of anastomosis by a few fine silk sutures.

In the first dog—autopsied two weeks after operation—the free uncovered anastomosis was the site of a few but rather dense adhesions, while both of the covered areas—the one being covered by omentum and the other by mesentery—were absolutely free from adhesions. There was no sign of peritonitis, adhesions about the free area being simply due to the attachment of the omentum to that area.

In the second dog, autopsied one week following operation, there was no trace of adhesions or peritonitis. In each case there was no free fluid in the abdominal cavity.

Following these experiments studies were undertaken concerning the effect of liquid paraffin in checking adhesions. In these cases some ten minutes before opening the abdomen, 100 c.c. of sterile paraffin oil was injected into the abdominal cavity by means of a large syringe and needle. This apparently large amount of oil was used because of the fact that during the operation a considerable amount of the oil would overflow through the wound.

The reason for the injection of the oil into the abdomen previous to operation was that the entire peritoneal surface would become thoroughly coated with a film of oil before being exposed to the air. All sponging at the time of operation was done with gauze saturated with the sterile oil. Four dogs were employed in this series, the operation in each case consisting of two end-to-end anastomoses. In each case, as will be noted later, there was an extensive exudation of leucocytes into the abdominal cavity. Because this exudation was so great, it was examined under the microscope and the granularity of the cells and their apparent fragmentation led us to believe that their functional

power as phagocytic agents might be diminished. The following method was adopted in the last two cases of this series, and in some of the cases of the following series, to test this phagocytic activity. Immediately after the abdomen was opened at autopsy about 25 c c of the exudate there found was collected in a sterile flask. This was then mixed with an equal amount of sterile, warm saline solution and centrifuged. This resulted in the throwing down of a considerable portion of the leucocytic cells which were again collected and rewashed until the leucocytic cream was freed from oil and of a uniform consistency. In these cases the animal was killed by ether and just before death the carotid artery was opened and 50 c c to 75 c c of blood obtained. This was defibrinated and centrifuged, a portion of the serum was decanted and placed in an incubator until the washing of the cells was complete.

The leucocytes from the blood were then washed simultaneously with those from the abdominal exudate, both samples of leucocytes being thus treated in the same manner so that there should be no difference in their activity because of variation in the mechanical manipulation. These two samples of leucocytes—one obtained from the exudate in the peritoneal cavity, the other from the blood of the same animal—were mixed with the blood serum from the same animal and a bouillon suspension of *Micrococcus aureus* in the proportions commonly used in obtaining the opsonic index for the blood serum, and incubated for half an hour. The leucocytes were the unknown factor in these cases and not the serum. The ratio of the number of bacteria taken up by the leucocytes from the abdominal exudate to the number of bacteria taken up by the leucocytes from the blood of the same animal is what we shall here call the phagocytic index of the given case.

The first animal died from a diffuse peritonitis nine days after operation. Autopsy showed no marked adhesions, though many fine fibrinous strands were adherent to the gut, the abdomen contained 125 c c of thick, oily and whitish exudate. The second animal was killed and autopsied ten days after operation. A local peritonitis was present about the operated areas with extensive adhesions matting the intestinal loops together, although these adhesions did not directly involve the operated areas, 200 c c of fluid was found in the belly, of the same character as that found in the previous case.

The third dog was autopsied seven days after operation, a general low grade peritonitis accompanied by fine plastic adhesions throughout the abdomen being found, 150 c c of the same characteristic exudate was present. The phagocytic index in this case was 3/14. The fourth dog was autopsied four days after operation and an extensive exuda-

tion with large amounts of sticky, fibrinous material generally spread over the gut but unorganized was found, 200 c c of exudate was present. The phagocytic index in this case was 4 15.

In considering the results in the foregoing experiments the question naturally arises as to whether the adhesions so constantly present were due to the presence of the oil or to some fault in technic. It was decided to inject the same amount of oil directly into the abdominal cavity and observe the result. In a series of three dogs 100 c c of sterile paraffin oil was injected directly into the abdomen by means of a large needle and syringe—the animals then being killed at intervals. The first dog, autopsied four days after injection of oil, showed exudate amounting to 200 c c with fine plastic adhesions throughout the abdominal cavity, the phagocytic index was 4 16. The second dog was autopsied eight days after the injection of oil, showed 125 c c of exudate and many plastic adhesions binding the gut generally in a mass, the phagocytic index was 3 17.

From the third dog, autopsied twelve days after injection, 160 c c of exudate was recovered and dense adhesions were found binding the gut into so firm a mass that it was impossible to separate the adhesions without tearing the serous surface, the phagocytic index was 0 16.

Because of the unsatisfactory results in our experiments thus far, it was decided to try in one case the injection of sterile olive oil. This was done in the same manner as before, the dog being autopsied eight days after the injection. Generalized adhesions throughout the abdomen were found, the exudate being extensive in amount. No attempt was made to determine the phagocytic index and nothing further was done with this substance.

At this time a question arose as to the purity of the paraffin oil used and, at the suggestion of Dr. Taylor, we determined to try the result of using glymol, a proprietary preparation, which he had found to be of a high grade of purity. This was used experimentally in three cases. In the first dog, the sterile oil was injected directly into the abdomen, no operative measures being employed. The animal was killed and autopsied three days later. The results were other than we had expected from our former work with paraffin oil. In this case only 80 c c of the oil had been injected because of the small size of the dog. At the autopsy only 60 c c of exudate was found in the abdominal cavity, the exudate presenting a clear, homogeneous appearance.

The leucocytes under the microscope appeared normal and the phagocytic index was 8 10. The gut was normal in appearance and no trace of adhesions was present. Because of this apparent good

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result, the operative measures used in the earlier cases were again resorted to. In the second series, 110 c c of sterile glymol was injected into the abdominal cavity before making incision. The gut was carefully protected and all sponging done with gauze saturated with the oil. Two end-to-end anastomoses, as in the former instances, were performed. The animal died thirteen days later from peritonitis, 250 c c of exudate was found in the cavity. Marked plastic adhesions binding the entire gut together were present, also a localized abscess at the lower point of anastomosis. Cultures from the fluid in the general abdominal cavity were sterile. The peritoneum was generally opaque. The last dog of this series was handled in the same way, save that only 90 c c of glymol was injected previous to operation. At autopsy, four weeks later, adhesions to the abdominal wound and around the operative site were found. A general fibrinous peritonitis of low grade was also apparent and small fat or oil droplets could be seen in the broad ligaments and omental lymph spaces. The exudate was 25 c c in amount and of the same character as found in cases where paraffin oil had been used. The few leucocytic cells present showed marked granular change and the phagocytic index was 0.12.

While still working on the use of oils, it occurred to us, as we were bleeding a dog into citrate solution, that if citrate prevented the normal ferment action in blood whereby fibrinogen was changed to fibrin, the same might hold true if the solution were placed in the abdomen after operation, thus limiting the formation of adhesions. This would, however, seem to be an attempt to limit a function which is normally necessary in the repair of serous surfaces. Adams distinctly states in dealing with the process of healing of serous inflammation that the first step in the process is the outpouring of an uncertain amount of plastic lymph which tends to glue the surfaces together, later to become organized and remain as scar tissue. Thus, if the formation of this plastic lymph were prevented would not the liability of infection passing from intestinal tract to peritoneum be increased, especially in cases where the gut had been opened? Our attention to this mode of dealing with adhesions was further stimulated by the results which Pope published in the ANNALS OF SURGERY, reporting the use of citrate solutions in checking adhesions in rabbits in cases where the peritoneum was simply scarified, though the gut was not opened.

To gain some personal evidence, citrate solutions were employed in seven cases in the following manner. As before, end-to-end anastomoses were performed in two sites with the same aseptic care as before, but

just before closing the abdomen 50 c c of a 3 per cent sodium citrate solution in normal salt solution was emptied into the cavity

The major thing noted at the time of operation was that, even with this small amount, it was extremely hard to keep the solution from running slightly over the edges of the abdominal wound. This caused a very marked oozing in each case, making the closure of the wound more than normally difficult.

The first dog of the series, autopsied two weeks after operation, showed imperfect healing of the abdominal wound, a gap into the deep tissues at least three-eighths of an inch being present at one end. Inside there were extensive adhesions of the omentum to the gut about the operative areas and some adhesions were present between the adjacent loops of intestine. Only a very small amount of fluid was present, a culture from which gave what appeared to be pure colon bacillus growth. In the second dog of the series, autopsied a week after operation, while the peritoneal edges of the wound were healed, the skin and fascial layers were imperfectly healed. Within the abdomen adhesions were present both of the omentum to the gut and of the adjacent loops of gut. In the third member of the series the abdominal wound split open on the third day after operation and the dog had to be killed. The fourth dog died from general peritonitis four days after operation, two local abscesses being present near the operative points. The fifth, sixth and seventh members of the series, autopsied fourteen, nine and seven days after operation respectively, presented similar pictures. General adhesions were present of the omentum to the gut in the neighborhood of the operative areas, and adhesions were present between the adjacent loops of intestine to a considerable extent. In none of these cases was distention noted nor was fluid found within the cavity. In no instance was there perfect healing of the abdominal wound, a distinct contrast with the former cases.

In discussing the above results we note that in five cases where no other means than simple careful technic and covering of the operative area with omentum or mesenteric strips were used, adhesions resulted in only one case, this being one where adhesions were found to the uncovered area, the covered areas in the same case being free. In eleven cases where some type of oil was used in the endeavor to limit adhesions, these were formed in nine cases. In one of the cases where adhesions were absent peritonitis caused the death of the animal, only a single case being free from adhesions or peritonitis. In all of the eleven cases more or less extensive exudation was present. In seven out of the eleven cases in which oil was used the phagocytic index was

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tested, and in all save the first experiment with glymol the index was markedly reduced, and even in this case it was not normal. This is shown more markedly by the accompanying chart, a study of which shows that in no case was the index higher than 8.10, once as low as 0.16, while the average index was about 4.17. From this work it can be deduced that oil in any form causes an intense exudation of leucocytes into the abdomen and these are inhibited from their normal physiological function by the presence of the oil, as indicated by the low phagocytic index. Thus it can be stated that oil is contra-indicated, if for no other reason than that anything which causes local migration of these cells and then checks their action simply increases the bulk of foreign material with which the tissues have to deal.

Substance Injected	Amount Injected	Amount of Exudation	Phagocytic Index	Time Autopsy
	<i>cc</i>	<i>cc</i>		<i>Days</i>
Paraffin oil	100	150	3.14	7
Paraffin oil	100	200	4.15	4
Paraffin oil	100	200	4.16	4
Paraffin oil	100	125	3.17	8
Paraffin oil	100	160	0.16	12
Glymol	80	60	8.10	3
Glymol	90	25	0.12	28

Another interesting fact in respect to oil is noted in that during the first four days following the injection of oil there is an excessive amount of exudation of fluid into the cavity, then in the next four days there seems to be a decrease in the amount of fluid, followed in the last four days of a twelve-day period by again increasing amounts. The explanation of this, of course simply a theory, is that the presence of the oil in the abdomen primarily calls forth an intensive cell exudation. In the process of adjustment absorption begins and the amount is temporarily decreased, but as soon as absorption begins, the lymphatics become plugged with oil and cell detritus and the further increase in the exudation is held within the cavity. This condition then remains for a long period, extensive exudation being present three weeks to a month after operation. That the oil is gradually absorbed by the lymphatics is shown by the presence of oil droplets in the lymphatics of the mesentery and broad ligaments in cases allowed to go for a long period.

From our experiments with the use of citrate solutions involving seven cases, there is not a single satisfactory result. Two deaths

occurred, one resulting from peritonitis, the other from the splitting open of the abdominal wound.

In all the other cases, five in number, the results are surprisingly similar, adhesions being noted in all instances, while a minor grade of peritonitis was present in one. In none of these cases was there satisfactory wound healing. This would certainly contra-indicate the use of such solutions in clinical work. Our results with the use of citrate solution in dogs are just opposite from the results which Pope obtained with the same solution in rabbits, in his work adhesions were limited and wound healing normal.

This we take to be due to the fact that we were working in areas where the gut had to be opened, thus exposing the area to the chance of infection, a factor not to be unconcernedly thrown aside. It is also probable that this procedure limits the normal production of plastic lymph so that seepage takes place through the lines of intestinal sutures, and a minor degree of infection follows which results later in the production of adhesions, though there is not enough infection present in all cases to give a definite peritonitis. The disagreement of our results with those of Pope's may be due to the fact that he did his work on rabbits, the peritoneum of which is generally known to be very resistant to infection, and that he was working under the artificial condition of the exclusion of possible infection. While we are not inclined to draw final conclusions, we would say that citrate solution is not indicated in cases where infection may be present, though it may have a field in those cases where infection can certainly be excluded, we would call attention in such cases, *ie*, where the adhesions are broken up without opening a certainly infected area—such as an abscess or the intestine—to the great danger which would follow if a focus of even mild latent infection were opened in the presence of a citrate solution. This statement is based upon the experimental evidence that the first step in the removal of infection from the peritoneal cavity consists in a gluing of the bacteria to the omentum—a process with which the citrate would certainly interfere.

These conclusions are almost identical with those reached by Momburg after using injections of oil in 16 clinical cases. Coffey also has lately expressed the same views in the use of oil.

The process underlying the formation of adhesions is a part of the process of the normal repair of all wounds of serous surfaces consisting, as pointed out above, in the outpouring of a plastic lymph which seals the lips of the wound. The problem therefore is not the prevention of adhesions, but the limitation of adhesions, if the outpouring

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of this plastic lymph be entirely prevented, the wound is not sealed and the entrance of bacteria from the intestinal lumen into the peritoneal cavity is unhindered

This problem of limiting adhesions therefore becomes the somewhat delicate problem of permitting the necessary adhesions and preventing the unnecessary ones. It does not seem to us that this delicate line can be drawn by the use of any chemical or physical method such as citrate or oil, and we return to the point so often reached by the surgeon, after some new idea has fostered false hopes, that all wounds of the peritoneum must heal by a process of lymph formation, which when carried too far means adhesions, therefore the only method of limiting adhesions is to limit the wounds of the peritoneum. The results of the work we here report show that this can be done by careful technic and by covering the necessary wounds with freed or attached portions of the omentum or mesentery

The most practical method for limiting adhesions consists in the clear understanding of the operator that the peritoneum is not a structure which can be cut and sewn, but a single layer of delicate endothelial cells, that the biologist obtains these cells for study by gently wiping the peritoneal surface with a gauze sponge, then pressing this sponge on a cover glass, and that every wound of this layer of cells begins to heal by the fundamental process of adhesion formation—the outpouring of a plastic lymph

THE TECHNIC OF CHOLECYSTECTOMY*

By EDWARD STARR JUDD, M.D.

OF ROCHESTER, MINN.

(Mayo Clinic)

THE two great dangers in removing gall-bladders are hemorrhage from the cystic artery and injury to the common bile duct. Hemorrhage may occur at the time of operation or may come later from slipping of a ligature. Injury to the duct may occur through clamping off the cystic duct too closely or, more commonly, through efforts to stop bleeding from a cystic artery which has slipped while being ligated.

Cholecystectomy is best accomplished from below upward. The important reasons for this are that the dissection from below upward is easier, and the circulation is controlled at the start. It is essential to know the condition of the common duct, head of the pancreas, and lymphatic glands before removing the gall-bladder and, in the dissection that exposes these, the cystic duct is freed.

Step I—The abdominal incision instead of being made over the normal location of the gall-bladder is made high and close to the mid-line, usually extending to the ensiform. Through this high incision, in most cases, much of the right lobe of the liver can be rolled out by using the gall-bladder as a tractor. If the liver is adherent to the parietal peritoneum, the adhesions should be freed before proceeding further, as the operation is much simpler if the liver can be displaced.

Step II—An assistant gently tracts on the pair of forceps which is caught to the fundus of the gall-bladder. The neck of the gall-bladder is then caught with a second pair of forceps and this part of the gall-bladder and the cystic duct are pulled away from the surface of the liver. Considerable fat and cedematous tissue may be encountered in this region, especially if there is an empyema of the gall-bladder, but this fatty tissue can be cleared away from the duct by a blunt dissection. Tracing down the cystic duct as a guide, the common duct is usually readily exposed by this traction on the neck of the gall-bladder. The neck of the gall-bladder and the lowest part of the body of the gall-bladder frequently lie alongside the cystic duct, so that when this is dissected out and pulled up the cystic duct is easily separated from the surface of the liver (Figs 1 and 2).

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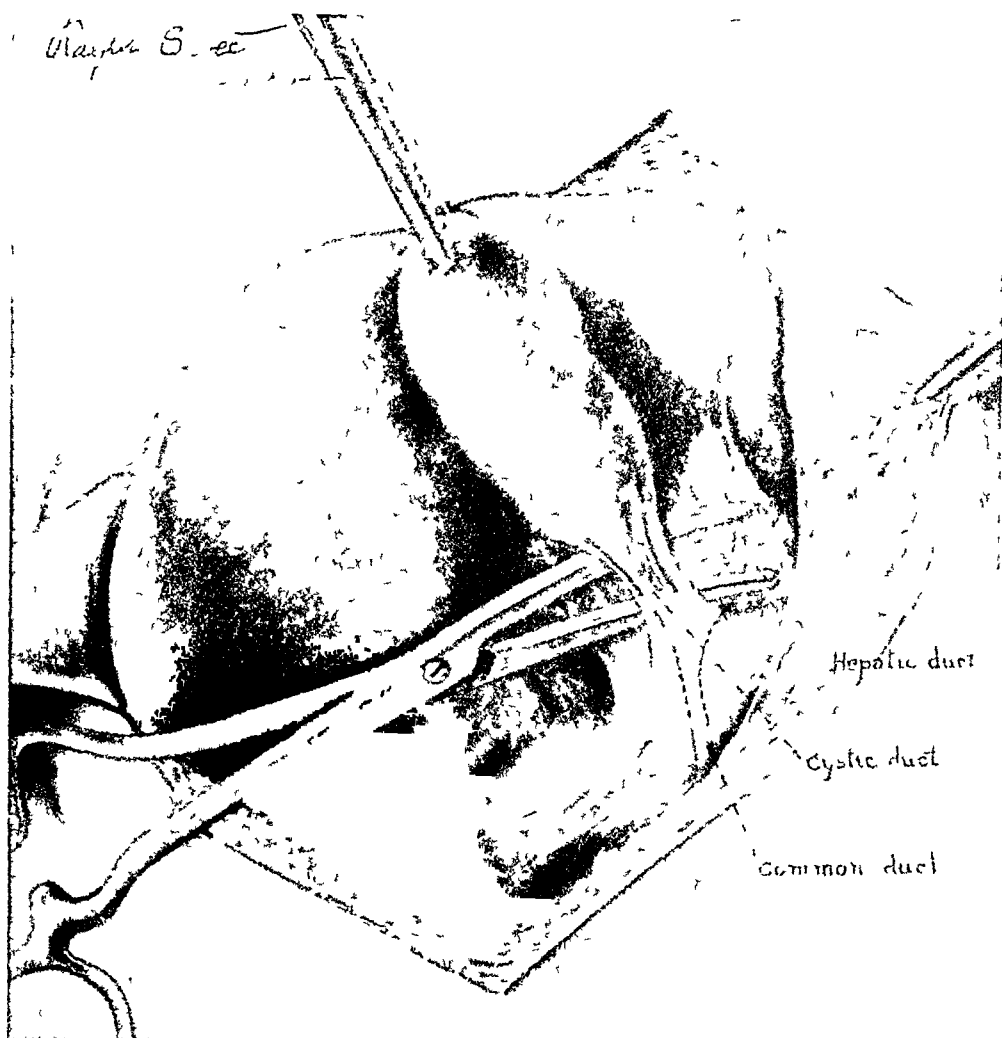


FIG 1 —High abdominal incision extending to ensiform if necessary. Grasping gall bladder fundus in soft clamps the liver is rolled out in the usual way. An additional clamp may be put on the gall-bladder near the cystic duct to tract the gall-bladder and cystic duct away from the liver so that by blunt dissection the cystic duct and artery are separated from the surrounding tissue.

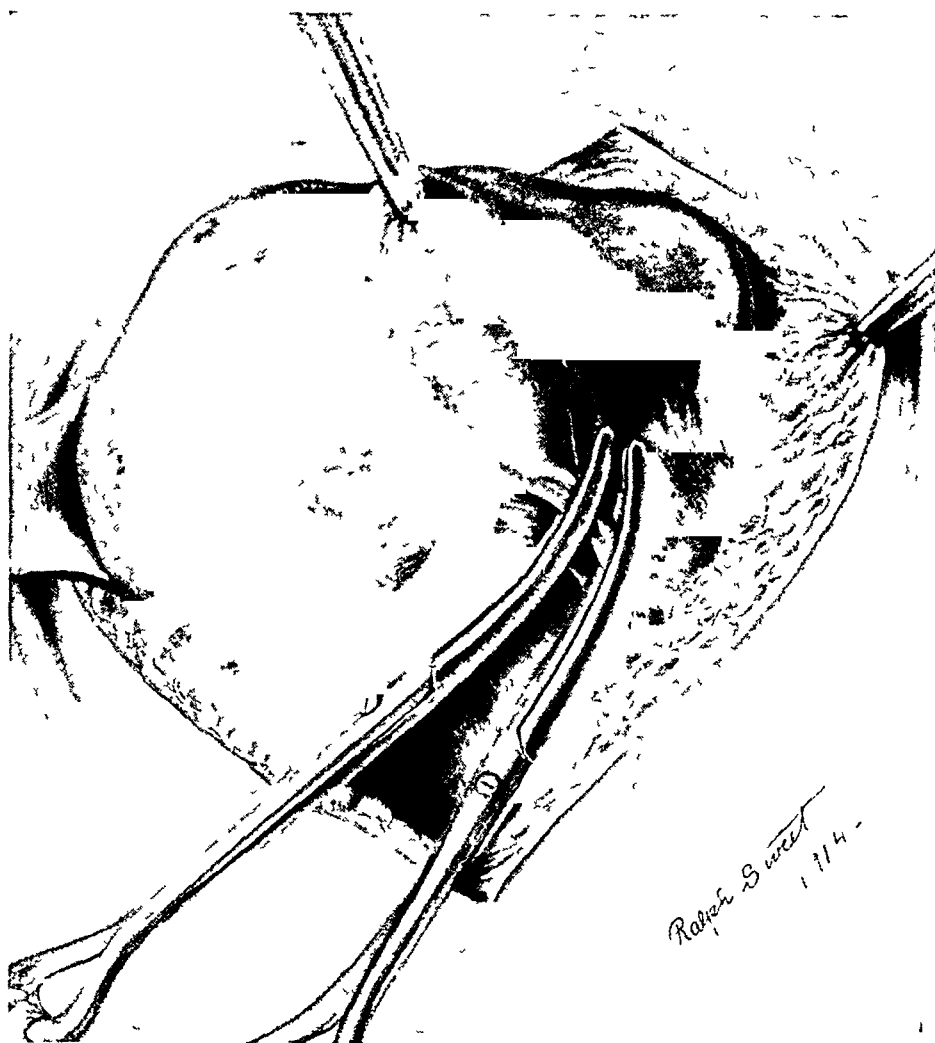


FIG 2 —Isolated cystic duct with vessels is clamped away from common duct



FIG 3—Cystic duct severed between clamps. Gall-bladder turned out. One clamp under the cut-off end of the gall-bladder catches any little vessels not included in the clamp on the cystic duct.



FIG 4 —Gall-bladder dissected out in the usual way and fissure in the liver sutured



FIG 5 —Drain down to cystic duct

THE TECHNIC OF CHOLECYSTECTOMY

Step III—The cystic duct and cystic artery are kept together. After these are completely freed from the surrounding tissues for the distance of a half inch to an inch they are caught together in two clamps and divided between the clamps. It is this particular step in the technic that I wish to emphasize. If the dissection at this point is carried out as described, the cystic artery is definitely ligated without tension and the common duct cannot be injured because the grasp of the forceps includes nothing but the cystic duct and artery.

Step IV—After dividing the duct and vessels between clamps, the end of the gall-bladder just cut off from the duct is pulled upward with a little tension, thus exposing the peritoneal folds and the communicating vessels at this point. These vessels are caught and the gall-bladder is dissected from its attachments to the liver (Fig 3).

Step V—The stump of the cystic duct and the cystic artery are now ligated with one ligature of ordinary catgut. It will be noted that this is done before the gall-bladder has been entirely removed. This attached gall-bladder makes an ideal retractor and traction on it gives good exposure for the ligation of the duct and artery. As soon as these structures are ligated, the ligature is cut and they are allowed to drop back free from the liver.

Step VI—A suture is now started through the cut edges of the peritoneal folds from which the neck of the gall-bladder has been removed. This is continued upward to the edge of the liver and is made to cover as well as possible the raw surface left on the liver. The gall-bladder is removed a little at a time and then a few stitches applied. If there is oozing from the surface of the liver, one or two extra stitches may be necessary, though usually a little pressure and relaxation of tension will control it (Fig 4).

Step VII—A small cigarette drain is placed down to the cystic duct and brought out so it will lie in the fissure from which the gall-bladder was removed (Fig 5).

This technic does not vary in many essentials from that often described. The important step in the operation is the complete freeing of the cystic duct before it is cut. Sometimes this is difficult, though it can be done in practically every case.

SOME EXPERIMENTS ON THE SURGERY OF THE PANCREAS [†]

By JOSHUA EDWIN SWEET, M D.

AND

I H SIMONS, M D.

OF PHILADELPHIA

(From the Laboratory of Surgical Research, University of Pennsylvania)

IN 1909 Coffey ¹ published a series of experimental operations designed to prepare a new exit for the external secretion of the pancreas applicable to cases in which the pancreatic ducts are occluded because of some pathological process in the head of the organ. The pancreas is not infrequently attacked by the pathological processes common to such glandular structures, notably benign and malignant tumor growths and by inflammation, the diagnosis of these conditions has made noteworthy progress, but the actual surgery of the pancreas seems to be limited to either indirect drainage through the gall-bladder, or, more rarely, direct drainage of the gland. The laboratory worker has little respect for the pancreas, and the fact that so much of our knowledge concerning the function of the organ is based on the experimental surgery of physiologists justifies the thought that the pancreas is able to withstand as much surgical maltreatment as any other vital organ.

Our studies were undertaken at the suggestion of Dr. Edward Martin without at first a knowledge of Coffey's previous work. Our conception was far more simple than the extended and elaborate procedure of Coffey, and our results seem worth communicating, because they fully support Coffey's conclusions concerning the surgical possibilities of the pancreas and because they offer a technic so simple that it could be executed with a trivial loss of time.

The condition in which such an operation would be indicated is in general that of a blocking of the pancreatic duct, in particular as seen in (1) carcinoma of the head of the pancreas, (2) carcinoma of the ampulla of Vater and the lower part of the common duct, (3) adenoma and chronic interstitial pancreatitis of the head of the pancreas, (4) cysts of the head.

* Read before the Philadelphia Academy of Surgery, November 2, 1914

¹ Coffey, *ANNALS OF SURGERY*, 1909, 1, 1238

SURGERY OF THE PANCREAS

The ducts of the pancreas are valveless. The direction of flow of the pancreatic juice can be reversed in the larger ducts, as is seen in the attempts to form a permanent pancreatic fistula in the dog. The pancreas of the dog always possesses two ducts opening into the intestine, a major duct, opening apart from the bile duct and draining the greater part of the organ, and a minor duct, opening at or near the ampulla of Vater and draining an independent island of tissue, but both systems anastomosing, so that a cannula placed in the major duct will not supply the investigator with pancreatic juice unless the minor duct be tied.

The pancreas of the dog corresponds in a general way to the human organ, with the addition of a process extending down the intestine from the head, called the *processus uncinatus*.

Our first experiments were to determine if a part of the pancreas could be separated from the remainder of the organ and successfully implanted in the gut. The *processus uncinatus* was cut off from the head of the organ, the duct in the proximal stump ligated, and the end of the uncinata process simply implanted in the intestine by dropping it through a longitudinal slit in the gut, which was then carefully closed by fine sutures. The best technic for this procedure appears to be in detail as follows. The pancreas is fastened to the intestine by a continuous suture placed about one-half inch from the cut end of the pancreas. This suture is carried around that half of the circumference which will lie beneath the organ, since that part is most difficult of access.

The intestine is then opened by a longitudinal slit, one-half of which wound lies within the area enclosed by this continuous suture. The pancreas is inserted into the lumen of the gut and the continuous suture completed about the remaining half of the pancreas, or in other words the technic corresponds to the first and fourth rows of sutures in a gastro-enterostomy. The three animals in this series were autopsied after six, five and four weeks. In all three cases the duct in the implanted portion was patulous and of normal size. In two there was no apparent atrophy of the pancreatic tissue. One had atrophied to one-third of the original size, microscopic study of the tissue showed no abnormalities. There was no fat necrosis, perfect anastomosis, and a very few adhesions. The other part of the pancreas was of course entirely normal.

In the second series of three animals an artificial obstruction was attempted by ligature of the ducts with implantation into the intestine of the proximal end of the pancreas after cutting off the uncinata process.

The first dog was autopsied after five weeks, and it was found that the new opening into the gut had closed, while a new duct had formed around the ligature of the major duct. The second dog died a week after the operation, from distemper pneumonia, and even in this short time a new duct had formed around

the ligature of the duct. The third dog, autopsied after five weeks, showed the same result—a new duct circumventing the ligature of the duct. None of these cases showed any gross changes in the organ, no pancreatitis, fat necrosis, or atrophy.

In the third series the pancreatic ducts were cut between ligatures and the omentum was interposed between the ends of the ducts in an attempt to prevent the re-formation of these ducts. The proximal stump, after excision of the uncinate process, was anastomosed with the intestine by the same simple procedure outlined above. This operation was tried in two cases which were autopsied four weeks after operation. The implanted duct was patulous. The ducts had not re-formed and there was no evidence of pancreatitis, nor fat necrosis, nor atrophy.

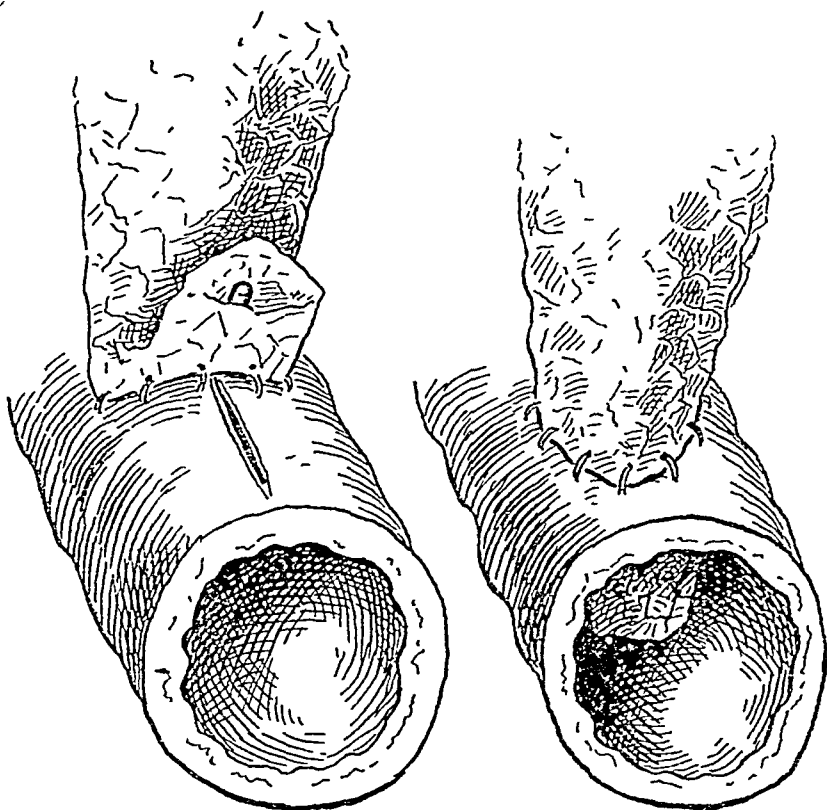


FIG. 1.—Diagrammatic representation of the method of inserting pancreas into bowel.

The persistency with which the pancreatic ducts reestablished themselves in the second series, and the well-known digestive action of pancreatic juice on the edges of a fistula led us to vary our technic in the third animal of this series in that the cut end of the pancreas, after blocking the ducts by interposition of omentum, was implanted in an opening of the gut which extended simply to the mucosa. We wished to see, in other words, if the pancreatic juice would provide an opening for itself through the mucous membrane. This animal died at the end of a week, the autopsy showing acute necrotic pancreatitis with fat necrosis and occlusion of the duct at the site of implantation.

SURGERY OF THE PANCREAS

The results of experimental studies can be judged either on the basis of the perfect uniformity of the results obtained in a relatively small series, or on a percentage basis of a large series. The number of the experiments described here is small, but the results are so entirely uniform, if we disregard the last animal, in which because of the modification of technic an entirely new problem was introduced, that we may safely conclude, first, that the pancreas can be anastomosed to the intestine by a simple technic, second, that there is little probability of pancreatitis, with its immediate dangers or its final result of atrophy, third, that the new opening into the gut will functionate, provided the normal openings are effectively obstructed.

A STUDY OF MULTILOCULAR CYSTADENOMATA OF RETROPERITONEAL ORIGIN

BY EDWARD STAEHLIN, M D
OF NEWARK, N J

MULTILOCULAR cystadenomata of retroperitoneal origin are of sufficient rarity (1907, five cases on record) to warrant the consideration of the following case Moore,¹ in his masterly monograph, was the first to ascribe to growths of this nature their correct etiological classification Before him the few cases that have been described were wrongly included under mesenteric or omental cysts, derived from some portion of the primitive omphalomesenteric duct, whereas the cysts under consideration are always of retroperitoneal origin (^{2,3,4})

Perplexing as it may be to correlate the structural characteristics, and the seat of the origin of these cysts, such correlation may nevertheless be reduced to a comparative simplicity, if we consider the embryological and anatomical relations of the genito-urinary system

Moreover, when we consider that the fully developed embryo, to say nothing of its future development, derived its incipency from a single cell, it seems as though it should be a comparatively simple matter to account for the origin and structural characteristics of the most complex cysts We are all familiar with the early segmentation of the original cell into two original cell layers—ectoderm and entoderm—and how in rapid sequence from the ectoderm forms another cell layer—mesoderm—which latter forms so early as to be regarded until recently primordial with the ectoderm and entoderm From these cell layers undergoes a most complete series of metamorphoses—a formation of all the different organs, a formation due to the inequality of growth of the different cells Each cell layer assumes its distinct function of developing its respective highly individualized, succinct group of organs

Consider now the wonderful metamorphosis the original cell undergoes, consider that the original layers are single cell layers, and consider the wonderful changes that they undergo, consider further what a single cell, let alone a group of cells, sooner or later might accomplish, when misplaced in course of their development, from one layer to another, and continuing to develop as an aberrant cell or group of cells—and you have an embryological conception of the incipency of new growth formations of this class

RETROPERITONEAL CYSTADENOMATA

CASE REPORT —*Clinical History* —The patient, a male, sixty-one years old (1911), born in United States, brass founder, aside from two attacks of renal colic two and three years ago respectively, has always enjoyed good health

Seven years ago, while being massaged in a Turkish bath, the masseur called his attention to a swelling in his abdomen situated to the right of the umbilicus, which he detected by accident. The patient then consulted a doctor who told him that the mass was as large as a good-sized orange and seemed freely movable, but inasmuch as it gave him no inconvenience he was advised to disregard it. Three years ago, while suffering from the first attack of renal colic, he was examined by another doctor, who incidentally examined this mass, and the patient was again advised to leave it alone, as its nature could not be determined, and as he was perfectly free from symptoms, though the mass had increased considerably in size. One year ago he was seen by a third doctor while in a second attack of renal colic, who also examined the mass casually and established the fact that in all probability it was an intra-abdominal mass of large size, but as the symptoms of renal colic had abated, the patient sought no further advice regarding the mass. These two attacks of renal colic were in the right side, the same side with the mass. During the past year this mass increased in size so as to become noticeable on the anterior aspect of the abdominal wall. It was to the right of the umbilicus and when palpated was smooth, convex, and in area it could be traced in expanse to the size of a child's head, when it disappeared in the hollow of the abdomen, was fixed, and the centre of convexity was in the waist-line over the right rectus, still there were no subjective symptoms other than an inconvenience when wearing a belt, half the mass would extend above and half below the belt, and the pressure caused by the slipping of the belt was the only inconvenience he had, on percussion there was flatness.

Seven A M, August 30, 1911, while bending over to lace his shoes, he felt a sudden giving way in his abdomen with a disappearance of all signs of the mass. He reclined on a nearby couch, summoned a doctor, who in turn summoned me, and we together saw him within an hour after the accident. He was in a supine position, talked freely, absolutely no shock, pulse and temperature normal, and solicitous only of getting our permission to resume his day's work. By noon his pulse was 90, temperature 100° F., at 8 P M, pulse 100, temperature 100° F. He was somewhat irritable, had considerable pain all over his abdomen—a dull, constant pain. Next morning at 8 o'clock, pulse 100, temperature 100°. The attempt to move his bowels was ineffectual, at noon pulse 100, temperature 100.5°, there was some distention of the

abdomen, it was slightly tympanitic, except over the right rectus and flank, where there was dullness. At 4 P M, pulse 116, temperature 101° F, the abdomen was more distended, the facial expression was anxious, no movement of bowels and no expulsion of flatus since his accident. The urine was normal and was passed voluntarily. It was decided to operate upon him, which was done 36 hours after the onset of the accident. The leucocyte count just before the operation was 18,000, showing a distinct polynucleosis.

Operation—An incision eight inches long was carried through the right rectus over the region where the swelling had projected, down to the peritoneum. The peritoneum appeared dark, as it does in large intra-abdominal hemorrhages. Immediately on incising the peritoneum large quantities of blood-stained, jelly-like substance welled out. The entire abdominal cavity was filled with it, including the pelvis, and the whole intestinal canal was bathed in it as were the spleen and liver. This substance was the contents of a huge cyst that had ruptured. The line of rupture extended in a line parallel with the ascending colon one-half inch anterior to it and five inches in length. The cyst wall was variable in thickness, from one-quarter to three-quarters of an inch, and firmly united to the ascending colon along its outer border, it was also firmly and broadly attached to the lumbar region. The cyst cavity had been only partially emptied, and as the hand was introduced, aside from the dark-stained, jelly-like substance, a large quantity of white-streaked, half-congealed fluid welled up, which had the appearance of chalk mixture or white paint. From within the cyst cavity (which cyst emanated from the lumbar region) the right kidney could be palpated, and the hand then extended over the kidney to Poupart's ligament below. Upward within the cyst the hand met with a round constriction the size of a half dollar in circumference which admitted three fingers, and, in introducing the three fingers, entrance was gained into another cyst cavity filled with the same kind of substance. Through this last cyst the liver could be palpated. The longitudinal axis of the entire cyst cavity extended from Poupart's ligament to the liver, and the anteroposterior axis, from the anterior surface of the right kidney to a point projecting at least one inch beyond the abdominal wall over the right rectus one inch below the umbilicus (see Fig 1). The cyst could not be enucleated, due to its tremendous base of attachment. The endeavor to bring its wall outside of the abdomen at the line of rupture so as to drain it wholly extraperitoneally was also futile, as the rent was deep, alongside of the lower portion of the ascending colon and firmly attached. A rubber dam was made and carried to the rent along the median side of the rupture, in the hope that it would direct the drainage extra-

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peritoneally The abdomen was thoroughly sponged out, and for this purpose large towels wrung out in hot salt solution were used, and just one dozen were stored away in the abdomen at one time, two in the cyst cavity The substance of the cyst was of a peculiar consistency It was jelly-like, would easily crumple between the fingers, and, though in places fairly firmly adherent to the abdominal viscera and parietes, it would not adhere to the sponge cloths When the towels were removed by torsion, in that way the jelly lumps could be more readily dislodged and made to stick better, the abdomen was found surprisingly clean It was effectively drained and closed by tension sutures The upper and lower portions of the wound were tightly closed, and the middle portion was left open as an egress for drainage tubes One of the original towels was left in the cyst cavity to expedite matters, as the patient was in a precarious condition. The cyst contents when examined showed the following

Gross Examination—Numerous large and small fragmented masses of a gelatin-like consistency and a coffee color, a slight amount of ropy pseudomucin which showed streaks of a chalk-like substance and considerable greyish-white opalescent substance

Microscopic Examination—Showed the gelatin-like substance to be composed of a colloid-like material very similar to the contents seen in a multilocular cystadenoma of the ovary The opalescent substance was composed almost entirely of pure cholesterol crystals, the chalk material of calcium soaps In the ropy pseudomucin were seen numerous large spindle-cells and an occasional polymorphous epithelial cell, numerous leucocytes and red blood-cells There were no echinococcus hooklets

The patient rallied slowly though effectively The points of interest during convalescence are that on the twenty-third day after the operation a fecal fistula appeared, which at times discharged profusely The cause of the fistula was in all probability due to the injury done to the gut, in the endeavor to separate the cyst sac, at the time of the operation He was discharged November 21 (82 days after the operation), with a small fecal fistula The blood examination on day of discharge showed hæmoglobin, 60 per cent, erythrocytes, 4,200,000, leucocytes, 10,000, polymorphonuclears, 66 per cent, lymphocytes, 32 per cent, basophile, 1 per cent, transitionals, 1 per cent. No abnormal red or white cells, mild secondary anæmia of the intermediate type He rapidly gained in weight and soon exceeded his accustomed weight and resumed the activities of his business From this time on he continued in his accustomed state of health, with only a slight inconvenience of a persistent small fistula, which, however, never healed entirely In the following May (eight months after the operation) the fistula began to discharge more profusely and he

complained of considerable tenderness over the area of the incision, and at times would have a temperature of 101° F. The discharge was of the same character as originally described, all of which proving that the lining membrane of the cyst wall was functioning actively. At this time, too, the kidneys first began to show evidence of a nephritis, numerous hyaline and granular casts with faint traces of albumin being found. Although greatly inconvenienced by the discharge, it becoming necessary to change the dressing daily, he still remained active in business until October, when he had an attack of influenza. From this time on he began to fail rapidly, losing his appetite, weight and strength, developing a cachexia and gradually becoming weaker until his death, May 24, 1912 (twenty months after the operation).

Autopsy and Pathology—A partial autopsy was allowed, and performed on May 25, 1912, after the body had been embalmed.

The following is abstracted from the protocol.

Causa mortis Chronic diffuse nephritis, chronic toxæmia, following prolonged suppuration.

External examination Male body about sixty-five years of age. Nutrition poor, considerable emaciation. Skin over entire body pale and wrinkled. All bony prominences markedly pronounced. Old healed laparotomy scar over right rectus, with small fistulous opening about its centre. No palpable lymph-glands. No abnormalities.

Internal examination Abdomen. On opening the abdomen the peritoneal cavity contained about 300 cc of straw-colored fluid. The viscera occupy their normal position, with the exception of the ascending colon and cæcum, which have been pushed slightly over towards the median line by the tumor. The tumor occupies the whole right flank, is covered on its left side by peritoneum, and is composed of a large, partly collapsed cyst with thick walls. The cyst cavity contains soft, friable and cheesy tissue, springing from the inner surface of the cyst wall and lying free in the cavity. This cyst cavity communicates with the outside by means of the fistulous tract in the abdominal scar. There is no communication of the cyst cavity with the general peritoneal cavity. Posteriorly the cyst springs from the lumbar region, between the upper pole of right kidney below and the liver above. The right adrenal is normal.

Studded over the parietal and visceral peritoneum, but chiefly the latter and particularly over the mesentery of the small intestine, are numerous small, grey, slightly raised nodules 1-4 mm in diameter.

Gross changes in the other viscera examined were Chronic degenerative and productive nephritis, chronic interstitial splenitis, chronic parenchymatous degeneration of liver, and pulmonary œdema.

Sections made from the cyst wall show the histological picture of a colloid cyst adenoma, similar in every respect to the multilocular colloid cystadenoma of the ovary (see Fig 2).

Sections made from the nodules found scattered over the perito-

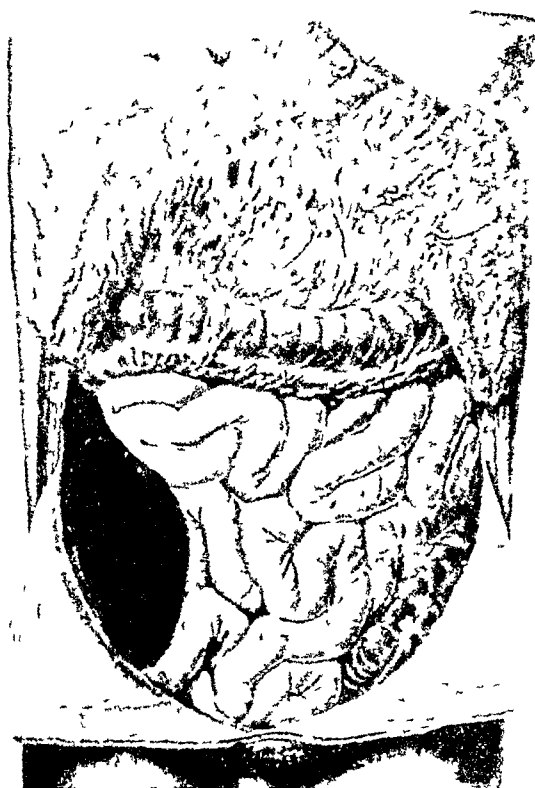


FIG 1a —Showing position of tumor as found at operation

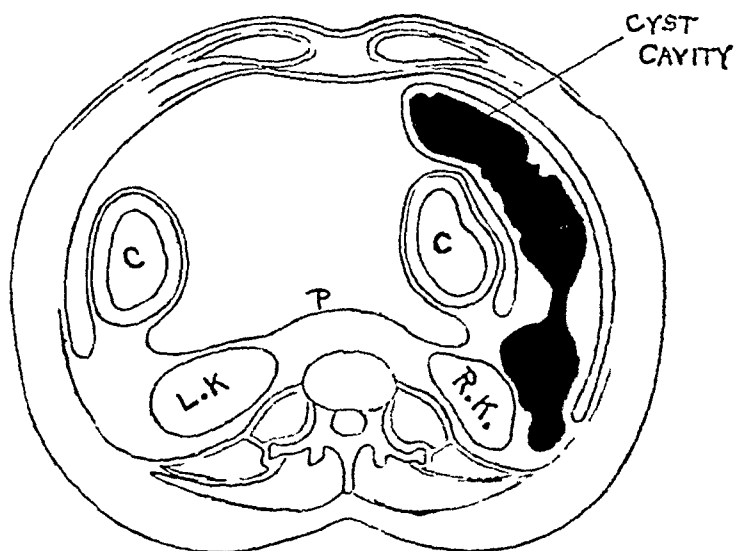


FIG 1b —Transverse diagram showing tumor



FIG 2 —Section from wall of cyst showing adenomatous character of lining membrane



FIG 3 —Section from peritoneum over mesentery of small intestine showing adenocarcinoma

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neum show them to be transplants of the original tumor, transplanted when the cyst ruptured and discharged its contents into the peritoneal cavity, and producing the so-called peritoneal metastasis with ascites, as is commonly seen in papilliferous cystadenoma of the ovary (see Fig 3)

EMBRYOLOGICAL EXPLANATION

A Development and Retrogression of Wolffian Body—The Wolffian body—mesonephros—undergoes segmentation by evagination of the mesothelium into cell cords, which in the pronephros remain solid cords, but in the mesonephros they develop into a series of transversely directed tubules which acquire a communication with the Wolffian or mesonephric duct. This duct, too, in the pronephros, known as the pronephric duct, is impervious. The Wolffian duct, known as the pronephric or mesonephric duct in its respective situation as it traverses through the pronephros or mesonephros, is formed by the invagination of mesothelial cells of the mesoderm to form a cord of cells. The pronephric portion posteriorly acquires some cells from the ectoderm also (an important fact, the deduction of which will be considered later). In the fully developed Wolffian body (seventh week of fetal life) it consists of the Wolffian duct, running parallel and lateral to the primitive vertebral column, emptying into the cloaca, and a series of transverse Wolffian tubules opening into the duct. As a further step in the development of an organ adapted to the function of the secretion of urine each Wolffian tubule is invaginated by a capillary branch of an artery from the aorta forming a glomerulus, which with its enveloping capsule of Bowman constitutes a primitive malpighian corpuscle, a structure analogous to the malpighian corpuscle of the permanent kidney. These transverse tubules of the Wolffian body are divisible into an anterior, upper or cephalic series distinguished as the sexual segment and a lower, posterior or caudal set of atrophic tubules. In mammals the functional activity of the Wolffian body is but temporary and is supplemented before the end of fetal life by the permanent kidney. In man retrogression begins at the eighth week of fetal life and the malpighian body has disappeared by the fifth month of fetal life.

B Sex Gland Differentiation—The generative organs of both sexes, in the course of their development, pass through a stage in which there is to be found no distinction of sex. This stage is designated as the undifferentiated sexual apparatus. While the Wolffian body is attaining its full development, there appears in its vicinity a tube the duct of Muller, parallel with and to the outer side of the Wolffian duct, its

exact origin has not yet been definitely made out, it is supposed to be produced by an invagination of the mesothelium of the body cavity in its upper portion, and the remaining lower segment results from a fission or a longitudinal division of the Wolffian duct. Its lower end opens into the cloaca, as does the Wolffian duct. While the duct of Muller is forming, the mesothelial cells overlying the surface of the Wolffian body toward the median plane undergo multiplication, forming an elongated swelling or ridge, this is known as the genital ridge (appears in the fifth week). Further differentiation of the genital ridge results in its transformation into the so-called undifferentiated sexual gland, a structure common to both sexes at this stage (see Fig 4). The mesothelial cells become modified in character and are called germinal epithelium, as they extend into the interior of the ridge or gland they give rise to

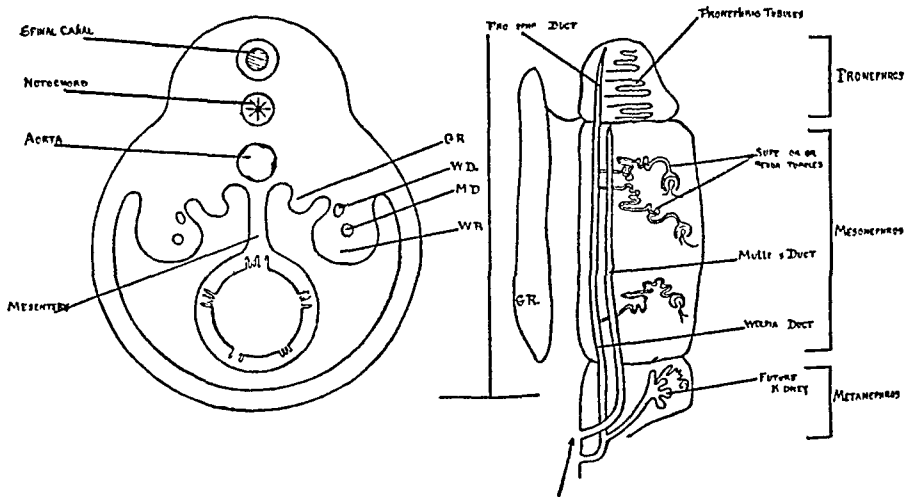


FIG 4—Diagram showing development of genital and Wolffian ridges

the germ cells, the ova or spermatozoa as the case may be, known at this stage as the primitive seminal cells or primitive ova. The undifferentiated sexual gland comes into an especially close relation with the upper anterior cephalic or sexual series of the mesonephros or Wolffian body. The elements of the undifferentiated stage of the sexual apparatus are therefore the undifferentiated sexual gland, the Wolffian duct and the duct of Muller, from this sexual stage, either the male or female type is produced by the metamorphosis of the undifferentiated gland into the testicle or the ovary, and the formation of the ducts to provide for the escape of the sexual elements, spermatozoa or ova, produced by them. The differentiation of the undifferentiated sexual system into the male type is effected by the further development of some parts and the atrophy or the arrested growth of the others. The

testicle has a double origin—the secretory part is produced by the metanephros and the undifferentiated sexual gland, while the system of efferent or excretory part is furnished by the Wolffian body, that is, by the anterior, upper or sexual tubules of the Wolffian body. When the metamorphosis is complete we have the seminiferous tubules, during fetal life, however, and even to the period of puberty these tubules remain as solid cords of cells. At the same time, also, marked changes occur in the Wolffian body, from the sexual, anterior or upper series of transverse Wolffian tubules cords of cells grow forth and penetrate the genital gland, their ends fusing with the primitive seminiferous tubules, the conversion of these cell cords into tubules furnishes the initial part of the system of excretory ducts of the testicle—the vasa recta and rete testis. Later the rete testis is extended to form the vasa efferentia and still later the efferent vessels lengthen and become tortuous, producing thereby the *coni vasculosi* or head of the epididymis. The upper part of the Wolffian duct develops into a convoluted tube which constitutes the head and tail of the epididymis, while the lower portion becomes the vas deferens, thus completing the system of canals provided for the escape of spermatozoa. It will be seen that while the secretory part of the testicle results from the metamorphosis of the undifferentiated genital gland (the secretory cells having their origin in the germinal epithelium) the complicated excretory system of ducts with which it is provided is furnished by the Wolffian body. The series of tubules connected with the upper extremity of the Wolffian duct, the remnant of the pronephros, frequently persists as a little pedunculated sac attached to the upper part of the epididymis and is known as the stalked hydatid or hydatid of Morgagni. The posterior, lower or atrophic set of Wolffian tubules likewise give rise to an atrophic structure, the paradidymis or organ of Giralde, constituting a series of short tubes closed at both ends, lying among the convolutions of the tail of the adult epididymis. The duct of Muller remains atrophic in the male through its entire extent, and with the exception of its two extremities it usually altogether disappears. Its upper extremity persists as a small vesicle, unstalked or sessile hydatid, attached to the upper aspect of the testicle. The lower extremity of the duct, uniting with its fellow, becomes converted into the uterus masculinus of the prostate gland. The change of location which the testicle undergoes is a conspicuous feature of its development. It becomes gradually displaced from its position at the side of the lumbar spine and by the third month reaches the false pelvis, by the fifth to the sixth month it is in contact with the anterior abdominal wall near the internal ring, by the

eighth month it enters the inguinal canal, and near the ninth month enters the scrotum (see Fig 5)

In the female the undifferentiated sexual gland becomes metamorphosed into the ovaries and, while the Wolffian tubules and Wolffian body become in the male system the excretory ducts of the testicle, they produce in the female merely atrophic structures. On the other hand, the duct of Muller which gives rise in the male to atrophic appendages, forms in the female type the Fallopian tube, and by fusing with its fellow of the opposite side, the uterus and vagina. The ovary results from the alterations in the structure of the undifferentiated genital gland analogous to those that occur in the evolution of the testicle, as in the

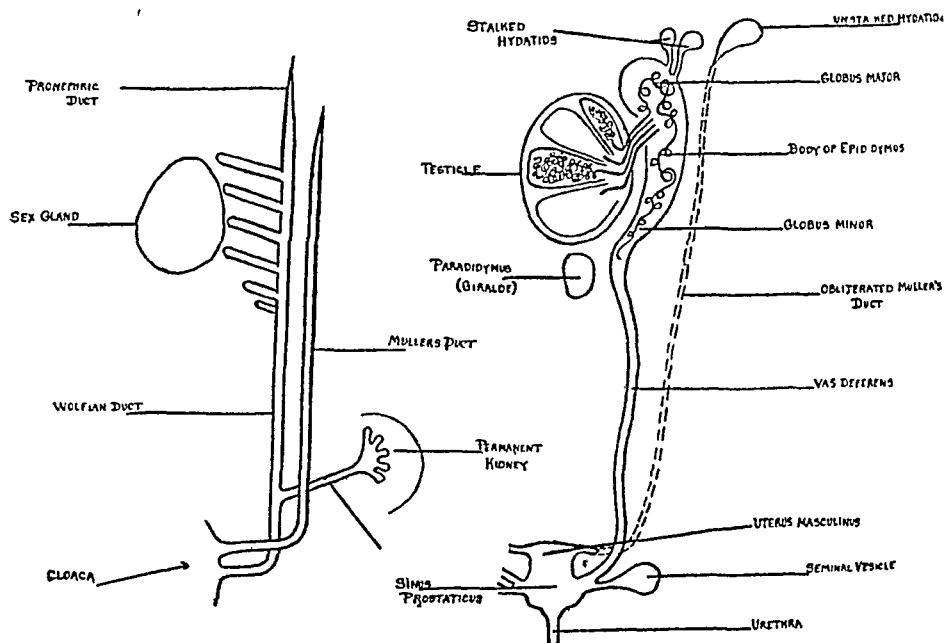


FIG 5 —Diagram showing undifferentiated and male genito-urinary systems

case of the development of the testicle, the mesothelial cells on the peritoneal surface of the genital ridge become thickened, constituting the germinal epithelium, these together with the indifferent mesodermic tissue form the sexual cords (primitive ova), forming into groups and constituting the Graafian follicles, the secretory system of the ovary, the excretory system results from the metamorphosis of the duct of Muller in its upper ununited portion into the Fallopian tube, in its lower fused portion into the uterus and vagina. The upper end of each single tube expands to form the fimbriated extremity of the Fallopian tube. The Wolffian duct, which in the male becomes metamorphosed into a part of the epididymis and the vas deferens, remains undeveloped in the female, producing merely atrophic or vestigial

RETROPERITONEAL CYSTADENOMATA

structures The upper series of the Wolffian tubules, the remnant of the pronephros, frequently persists, as in the male, in the form of a small pedunculated sac, the stalked hydatid or hydatid of Morgagni. When present it is found in the broad ligament in the neighborhood of the outer extremity of the ovary. The anterior or sexual series of the Wolffian tubules with adjacent part of the Wolffian duct, which in the male type develop into the epididymis, become, in the female, an atrophic structure known as the epoophoron, paroovarium or organ of Rosenmüller. This structure is almost constantly found between the layers of the broad ligament in close proximity with the ovary, and consists of a large horizontal tube, representing a segment of the Wolffian duct, and of shorter vertical tubes joining this at right angles, which represent the transverse Wolffian tubules. The lower set of Wolffian tubules,

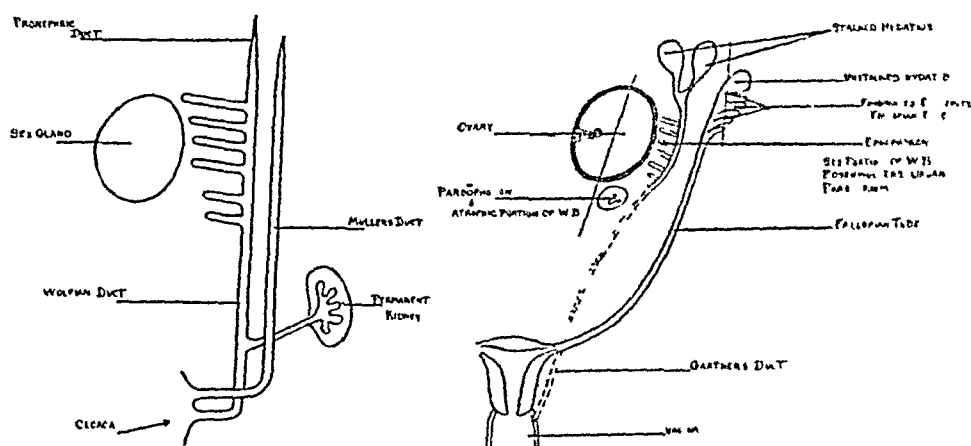


FIG 6 —Diagram showing undifferentiated and female genito urinary systems

those which in the male become the paradidymis, give rise to a homologous atrophic body in the female, the paroophoron. This is also situated in the broad ligament to the inner side of the ovary. The Wolffian duct, except that portion of it that develops in the formation of the paroovarium, usually entirely disappears, occasionally it persists as a small canal traversing the broad ligament close to the uterus, to be lost in the upper part of the wall of the vagina, near the urinary meatus. When it persists it is known as the duct of Gaertner. The change of position of the ovary is similar to that of the testis, the difference being that the testis undergoes an external descensus, during which no alteration of the relative position of the parts occurs. The ovary rotates through 90 degrees and comes to lie with its axis horizontal (see Fig 6).

C Origin of Cystadenomata—Cysts may arise from unabsorbed remnants of any of these embryonic structures. The situation of

the cyst depends upon the situation of the unabsorbed remnant of the embryonic structures, that is, the cyst may develop from vestiges of the Wolffian body in their original, abdominal, retroperitoneal situation, or from vestiges after they are carried down with the descent of the testicle or ovary in their course of migration

The nature of these cysts depends upon the nature of the original cell layer from which they gain their origin, and as the vestiges are derived almost exclusively from the evaginative and invaginative processes of the mesothelial cells the cysts are adenomata (exclusive of simple retention cysts) In general the cysts consist of a simple large, thick-walled cyst, having attached to its interior a variable number of smaller and thinner-walled cysts, and contain a seromucous material occasionally discolored by extravasated blood pigment, besides cholesterolin and calcium salts "Cyst formation of this type may, however, present a much more complex anatomical picture, and may manifest a capacity for progressive new growth and extension, which endows it with the features of malignancy The two forms are identical in their fundamental structure but differ in their capacity for growth and extension" ¹ "The one is characterized by a formation of a primary cyst within which the proliferative changes are confined and which results in the production of cysts The other by a greater proliferative capacity resulting in the production of a tumor composed of a congeries of cysts on any one of which it is impossible to confer the distinction of being primary, and peculiar by its powers of extension in the tissue plane in which it originates and the consequent involvement of distant parts" ¹

Clinically, we find these cystadenomata in the form of a typical uni- or multilocular cystadenoma of the female arising from vestiges of the parovarium, and the more complex and more malignant papilliferous cystadenoma arising from vestiges of the mesonephros in the hilum of the ovary, which with the migration of the ovary have been carried down from their primitive abdominal position In the male, as in the female, very similar conditions exist The vestiges of the mesonephros normally are displaced from their abdominal position with the descent of the testicle and in the adult are recognized in the organ of Giraldu (paradidymis), and in certain cell groups situated in the tissue of the hilum of the testis From these tumors may originate which in structure are cystadenomata, either simple or papilliferous, and which are homologous with hilum cystadenomata of the ovary Both in the male and female aberrant portions of the mesonephros may retain their primitive abdominal situation and give rise to retroperitoneal cystadenomata identical with these tumors of the ovary and testicle

RETROPERITONEAL CYSTADENOMATA

Thus far all cyst formations considered have been true cystadenomata of mesothelial origin, should, however, the posterior layer of the impervious pronephric portion of the Wolffian duct be involved in the formation of the cyst, and since it is derived not only from mesoderm but ectoderm, it is my opinion that we may get a dermoid cyst either in male or female intra-abdominal, testicular or ovarian in situation. Some authorities have spoken of this entire class of cysts as dermoids, this is impossible, since the condition *sine qua non* of dermoids is the involvement of true skin as their lining¹

CONCLUSIONS

We have then a class of cysts which invade the peritoneal cavity in their course of development, which contain colloid material, cholesterol, calcium salts, etc, which may occur in the male or female, which may be uni- or multilocular, which may be benign or malignant, and which are always of retroperitoneal origin, arising from vestigial remnants of the mesonephros

I wish in conclusion to make my grateful acknowledgments to Dr H S Martland, Pathologist of the City Hospital, for active help and counsel in the preparation of this article

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THE SURGICAL SIGNIFICANCE OF INTESTINAL ANGIO-NEUROTIC ŒDEMA

WITH AN ILLUSTRATIVE CASE

BY ARTHUR H. BOGART, M.D.

OF BROOKLYN, NEW YORK

SURGEON TO THE METHODIST EPISCOPAL AND CONEY ISLAND HOSPITALS ASSISTANT SURGEON TO THE
KINGS COUNTY HOSPITAL

WITHIN the past eight or ten years a number of cases have come under our observation of what seemed to be acute intestinal obstruction. They have usually occurred in males between the ages of thirty and forty-five years.

The history in each of these cases has been somewhat as follows.

A sudden onset, with abdominal pain, nausea, vomiting and distention, with inability to move the bowels. These cases, as a rule, have been treated by the family physician as cases of acute indigestion due to errors in diet, but, failing to respond to the usual treatment, we have had an opportunity of seeing them with a view to surgical interference.

When seen by the writer, usually about 48 hours after the beginning of the symptoms, the chief complaint has been intermittent, cramp-like pains in the abdomen, nausea, vomiting of a dark bilious material, with occasionally a decided fecal odor, abdominal distention, great prostration and an inability to have a satisfactory movement of the bowels. The pulse is usually rapid and feeble and the temperature slightly, if at all, elevated.

The picture as presented by these cases has been that of a very serious illness, probably intestinal obstruction, requiring operative relief, and yet a number of them have recovered without operation, usually by the use of repeated enemata and lavage.

Heretofore, we have been unable to satisfactorily explain to ourselves the cause of such an alarming array of symptoms and the complete recovery of patients from what seemed to be a desperate illness when recovery without operation seemed impossible.

It has occurred to us that the following case is worthy of report, in that it suggests at least the rôle which angioneurotic œdema may play in the production of such a group of symptoms.

A. D., aged forty-two years, steward by occupation, referred by Dr. J. Dusseldorf.

The present illness began suddenly two weeks before admission to

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the hospital While working, the patient became nauseated and several times vomited a greenish fluid, but had no particular pain at this time For the next few days he was sick in bed, unable to work, and suffered from nausea and vomiting and inability to get the bowels to move satisfactorily At the same time he suffered from abdominal distention and a feeling of fulness in the epigastrium Repeated doses of medicine failed to move the bowels, nor was the patient able to pass gas as usual At the end of ten or eleven days he improved and returned to his work, but was taken worse and had to return home That evening he began to suffer from severe abdominal pain located in the upper abdomen and colicky in character The nausea and vomiting returned and became very distressing The vomitus was at first bilious in character, but later had a decided fecal odor, as suggested by the wife of the patient and confirmed by myself and the attending physician The pain became so severe as to require repeated doses of morphia during the night

The writer saw the patient early on the following morning, and found a well-nourished man with a rapid, thready pulse and a cyanotic condition of the skin He was vomiting frequently the same material as described above The abdomen was markedly distended, particularly in the epigastric region, and he was suffering from intermittent cramp-like pains, chiefly in the upper abdomen There was some tenderness in the same region The temperature was normal There had been no passage either of gas or fecal matter from the bowels for 48 hours, although every effort had been made to secure one The patient also complained of a stiffness and pain in the muscles of the back and arms and, when attempts were made to move him from side to side, there was apparent a general rigidity of the body, such as is seen in tetanus cases When not vomiting, the man was continually spitting up material and belching gas

We considered the case one of intestinal obstruction high up, but on account of the very desperate condition of the patient and previous experiences in similar cases, thought better to secure the services of a trained nurse and advised stomach washing every four hours and high enemata, in the hope that he might improve This treatment was instituted and carried out during the night, with the result that on the following morning the patient's condition was very much better The pain had been relieved, vomiting had ceased, the bowels had moved fairly satisfactorily in response to the enema, the pulse had come down from 140 to 90 and was of good character In fact, the patient's condition was so good that we gave a favorable prognosis at this time He remained fairly comfortable during that day, but the symptoms returned during the night and, when seen the following morning, operation seemed imperative, was advised and accepted

Operation—The stomach having been washed out, the patient was etherized and a right rectus incision made about four inches long Upon opening the abdomen it was found to contain a considerable quantity of blood-stained fluid, such as is commonly found in cases of ileus Inspection of the appendix showed it to be normal, but it was removed The lower ileum was somewhat distended and congested, with a few ecchy-

motie spots The intestine was now followed upward from the ileocæcal valve (the distended portion was not more than a few feet in length), after which the intestine was apparently normal in appearance *until we came to the jejunum, which was found to be in a very much swollen and œdematous condition This swelling and œdema extended up to the point where the intestine passes beneath the mesentery, and was so pronounced as to produce a stiffening of the intestine sufficient to prevent peristalsis When grasped between the forefinger and thumb, the intestine was apparently at least one inch in thickness Evidently, the lumen of the bowel was almost, if not completely, obliterated by this swelling and œdema* No further evidence of obstruction having been found, the wound was closed

The patient bore this operation well, but the after-course of the case was such as to make us feel that but little benefit, if any, had been derived from it The distention, particularly of the stomach, was marked, and had to be relieved by frequent washings, the benefit of which was very prompt, as shown by the improvement in the patient's general condition The bowels did not move for several days and when they did begin to move the patient developed a diarrhœa with the passage of blood in small amounts He gradually improved, however, and was discharged at the end of seventeen days after the onset of his symptoms

NOTE—Ten days after leaving the hospital, this patient developed œdema of both feet, one hand, and the left side of the chest It cleared up rapidly in the feet and hand, but is still present in the chest wall, twenty-seven days after the onset of his symptoms This tends to corroborate the diagnosis before made in the case

Osler, in his *Modern Medicine*, vol v, in speaking of the gastrointestinal tract in angioneurotic œdema, says

"This is involved in 34 per cent of cases (Collins), ten of my patients had attacks of colic We know now the nature of the local trouble, as exploratory operations have confirmed the view that it was an œdema of the wall of the bowel, and in a case reported by Morris, in washing out the stomach to relieve the severe vomiting, a portion of the mucosa was removed and on examination was found to be in a state of acute œdema

"Colic is a common abdominal symptom, coming on suddenly and often reaching an extreme grade As a rule, it occurs with the skin manifestations, but it may be the only feature, and there may be no clue to the nature of the trouble In the majority of cases it is a 'dry colic,' the pain central, more or less continuous, with paroxysms of greater intensity The patient may roll about in the bed or be doubled up in an agony of pain The abdominal walls are tense, there is not often tympanites and there may be no local tenderness Appendicitis, gall-stone colic or renal colic is suspected, and in a considerable number of cases laparotomy has been performed In severe attacks with the colic there is vomiting coming on with the pain and lasting for many hours The patient may look very ill, with pallor, small pulse and features of collapse, and at the end of ten or twelve hours the symptoms may all disappear and an outbreak of local œdema gives the diagnosis

"With the gastric symptoms and colic there may be intestinal symptoms,

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diarrhœa, meteorism and even the passage of blood" He further states that "the abdomen may be swollen and tender, and the picture, sudden onset, vomiting, pain, diarrhœa, pallor, with feeble pulse, may suggest perforation of a gastric or duodenal ulcer. The passage of blood in children may suggest intussusception."

He fails, however, to mention intestinal obstruction as a possible error in diagnosis, which to us seems to be a very important point and one to be considered, for there is no doubt in the mind of the writer that the condition as described was the sole cause of the symptoms in the case reported, which were those of an acute intestinal obstruction.

If we are correct in our conclusions, it is evident that operation is contra-indicated, rest in bed, stomach washing, enemata and supportive treatment are suggested.

SECONDARY ULCERS OF THE STOMACH AND JEJUNUM FORMATION OF CALCULI AROUND UNABSORBABLE MATERIAL USED IN SUTURING THE INTESTINAL MUCOSA *

By A. L. SORESI, M.D.

OF NEW YORK

I SECONDARY ULCERS OF THE STOMACH AND JEJUNUM

THE existence of ulcers (especially peptic) around the new opening made by gastro-enterostomy has been reported in a sufficient number to make it a subject of interest to the surgeon. The following case led the author to study what effect silk and linen thread might have on the complete cicatrization of the operated mucosa of the stomach and of the intestines, and, therefore, on the production of secondary ulcers.

Mrs. M. A., aged twenty-nine, was operated on by the author for an ulcer of the duodenum by posterior gastro-enterostomy. The condition of the patient did not permit at the time of the operation to remedy other pathological conditions of the adnexa. The gastro-enterostomy was performed, using silk for both the through-and-through and the seroserous sutures. The patient made an uneventful recovery, gained in weight and was well. After about four months from the operation she had gained seven pounds, but was complaining that she had pains in the middle of the stomach if she was not exceedingly careful about her diet, and the pain was not getting any better, she had the impression of the pain being caused by swelling of the stomach. One hundred and forty-eight days after the gastro-enterostomy, the author made a second laparotomy in order to remedy the condition of the adnexa. The site of the former operation was carefully examined and was absolutely in a perfect condition, no adhesion and no kinking being present. As it had been promised to the patient that the cause of the pain would be investigated, a small incision in the anterior surface of the stomach was made, with the idea of using it as a possible opening for an anterior gastro-enterostomy, if it was necessary to perform it. The gastro-anastomotic opening was very plainly visible, had not contracted, and it showed that the silk was still in place and that there was a small ulceration of the mucosa of the stomach and another on the mucosa of the jejunum. The silk was removed, the stomach closed, and the patient made an uneventful recovery, and has not complained since of any pain, twenty months after the second operation.

* From Dr. Sorin's Surgical Institute

SECONDARY ULCERS OF STOMACH AND JEJUNUM

Posterior gastro-enterostomy was performed 47 times on dogs, by the author and students taking courses, using silk or linen thread for the through-and-through and the seroseous sutures. At the autopsies, which were performed from one to ten months after the operation, the silk or linen thread was present, hanging in the inside of the stomach, in all but one case. There has never been any mortality due to the operation and all the animals were in good condition when sacrificed. Briefly the operations where the above-mentioned complications were present are as follows.

Dog No 1, female, operated on eight months before autopsy. Ulceration of gastric mucosa and presence of hair twisted with the thread, as shown in Fig 1, silk was used and pylorus excluded. Dog No 2, female, operated on four months before autopsy. Ulcerations of the mucosa of stomach and jejunum (Fig 2), linen was used. Dog No 3, male, operated on four months before autopsy, ulceration of the mucosa of the jejunum (Fig 3), linen was used.

From the above experiences it would be reasonable to draw the following conclusions:

Unabsorbable material, silk or linen, is not eliminated after a period of ten months in animals, the peristalsis of which is very strong and which eat very rough food, such as bones and large pieces of meat.

The presence of the silk or linen thread is liable to cause ulceration of the mucosa of the stomach and the jejunum, this has occurred in three cases out of 47 or approximately 6 per cent. None of the animals seems to have suffered from the presence of the ulcerations.

Exclusion of the pylorus did not seem to have any effect, as only one animal out of seven in which the pylorus was excluded showed the presence of ulceration.

Silk and linen thread behaved about in the same manner, out of 47 cases silk was used in 26 and linen in 21, and ulcers were present in two cases where silk and one case where linen was used; this would seem to give a little preference to linen, but to the author it seems that a larger series would show about the same results in the use of either.

Of clinical value to the practical surgeon and in reference to human beings the following conclusions seem to be reasonable:

Unabsorbable thread, silk or linen, will practically in every case be present in the gastro-anastomotic opening for a long time.

There is no technic by which the thread might be made to be eliminated with what would be called mathematical certainty, because in the through-and-through suture the thread that engages the tissues,

which will later slough off, should be eliminated with the tissues that are sloughing away and are therefore eliminated. It is easily understood, that no matter how skilful and careful the surgeon is, it is impossible to keep the suture on a mathematical straight line, some stitches will go through the tissues a little more deeply than others, with the results that when sloughing of the tissues engaged in the suture begins, the suture becomes loose and the tissues engaged by the more superficial stitches will be eliminated first, regeneration of tissues begins by elimination of the dead tissues and where the stitches have occasionally been deeper, regeneration will take place around the thread, because the thread by not being taut does not cause any further sloughing. The thread will remain indefinitely in place, hanging from one or more points in the stomach or intestinal cavity.

It is evident that the presence of foreign material in the mucosa of the stomach and intestines will keep up a sort of irritation to the tissues and at the point of emergency of the thread will facilitate the infection of the mucosa and its dissolution by the acids of the stomach. That many patients who still complain of symptoms after a perfectly executed gastro-enterostomy are suffering from small ulcerations of the mucosa around the anastomotic opening is very probable, and that later some of them get better might be due to the fact that finally the unabsorbable material is eliminated and the mucosa has a chance to heal perfectly, as when the surgeon has occasion, as the author had, to remove the threads directly. It is also reasonable to think that patients with a very high acidity are more liable to suffer from the presence of the suture material in the stomach. That no more patients suffer from the presence of the suture material in the stomach might be explained by the fact that generally patients who have had to undergo a gastro-enterostomy are careful about their diet and follow some kind of medical treatment for some time, which would relieve symptoms.

As no trouble was apparently caused in the animals by the presence of the thread or even of the ulcers around the gastro-anastomotic opening, the percentage of which is low, it might seem useless to lay so much stress on the danger of using unabsorbable material for the through-and-through suture. We must take into consideration that the experiments were made on perfectly healthy dogs, which did not very likely have any tendency toward ever having any trouble with their stomach and intestines, and if we refer what has occurred in these healthy dogs to people who have to be operated upon on account of ulcers of the stomach and duodenum, we will easily understand that the facts are really important.

SECONDARY ULCERS OF STOMACH AND JEJUNUM

It is well to say that although a great number of surgeons have had splendid results from the use of linen and silk the facts mentioned above cannot be denied, and of importance to the surgeon is the question of "What is best to use?" With the perfection of technic the mortality from gastro-enterostomy should be *nil*, and in the hands of the competent surgeon it is practically so, our aim therefore is to avoid any unnecessary complication, no matter how trivial it might be, the formation of ulcers favored by the long-time presence of unabsorbable material in the mucosa is a really serious complication at times and really annoying always, even if it should not last long, therefore, we have to use a material that can be absorbed in a reasonable time, so giving the best of facilities to the mucosa to heal perfectly

The author thinks that silk or linen should be used for the seroserous suture, because the serosa tolerates perfectly well the presence of unabsorbable material, and its presence might even help in the formation of strong adhesions, *that catgut, chromic or iodized, or even plain, should always be used for the through-and-through suture*

It is well to state in a few words what happens in suturing the three coats of the stomach and the intestines, as it is done in the through-and-through suture in performing anastomosis and in repair work. The thread approximates tightly the three coats so that the blood-vessels are firmly secured and bleeding prevented. If this is done properly, it means that the blood supply of the tissues immediately interested in the suture is completely cut off, therefore they will slough and fall. The mucosa interested in the suture will also fall off, leaving a space not protected by mucous membrane. Leakage would occur very often, if suturing of the gastro-intestinal tract were done only with the row of suture known as the through-and-through suture, because sloughing might occur before firm adhesions have taken place between the serous coats, for this reason a seroserous suture is put in around the through-and-through. Adhesion between the sutured serous coats forms very rapidly and is evident a few hours after operation, adhesions between mucous coats are very slow, a perfect complete repair of the mucosa might take over a month. So long as the through-and-through suture is made only to prevent bleeding and approximate the cut edges, we have to see whether an absorbable material will do this or not. The process of sloughing of the mucosa begins 24 hours after operation and is generally completed from 5 to 20 days after.

It is evident that when the process of sloughing is fairly advanced, that is, from the third day to the fifth day after operation the hæmostatic power of the suture must be *nil*, in any event if the suture has

not caused the production of thrombi in the blood-vessels strong enough to insure hæmostasis, bleeding would occur no matter what suturing material has been used. Therefore, if we use a suture material that can last over three days, we can be sure that we have done everything in our power to insure the best hæmostasis. Chromic or iodized catgut No. 1 will last much longer than three days, even in the stomachs of dogs, *and therefore chromic, iodized, or even plain catgut should always be used in through-and-through sutures in the gastro-intestinal tract*

It seems reasonable to think on the strength of this argument that the cases reported in which leakage or hemorrhage was attributed to the rapid absorption of the catgut used for the through-and-through suture have been due to other causes.

In contrast with the reported case and experiments, the author has been using catgut for the through-and-through suture in over one hundred cases in human beings and in animals, with the most gratifying results in the former, and always finding at the autopsies of the latter a perfectly healed mucosa. Catgut has also been used in many animals for the seroseous suture without any ill results, adhesions of the serosa being absolutely perfect. The author is studying the mechanism of repair of the stomach and intestines, which will be reported when completed, for the present he would like to draw the following conclusions:

Catgut No. 1, either chromic, iodized, or even plain, should always be used for the through-and-through suture, as experiments and clinical experience have shown that silk or linen is almost always hanging in the stomach and intestines an exceedingly long time after operation.

The presence of the thread in the stomach might help the formation of new ulcers.

Silk or linen is to be used only for the seroserous suture.

II FORMATION OF CALCULI AROUND UNABSORBABLE MATERIAL USED IN SUTURING THE INTESTINAL MUCOSA

While studying the effects of unabsorbable material in suturing the mucosa of the stomach and jejunum in gastro-enterostomy, some experiments were also made on the effects of the same unabsorbable material in the through-and-through suture of intestinal anastomosis. While there has never been any ulceration of the intestinal mucosa around the points of emergence of the thread, and the mucosa had healed perfectly, other interesting phenomena took place.

Hairs twisted
around thread



Fig 1

Fig 3



Fig 2



Ulceration of stomach
and jejunum

Fig 4



FIG 5



FIG 6



FIGS 1, 2 3 4 5, and 6 which are photographs of specimens show the presence of the thread hanging loose in the new stoma made by the gastro enterostomy

FIG 7

Large calculus formed around silk thread

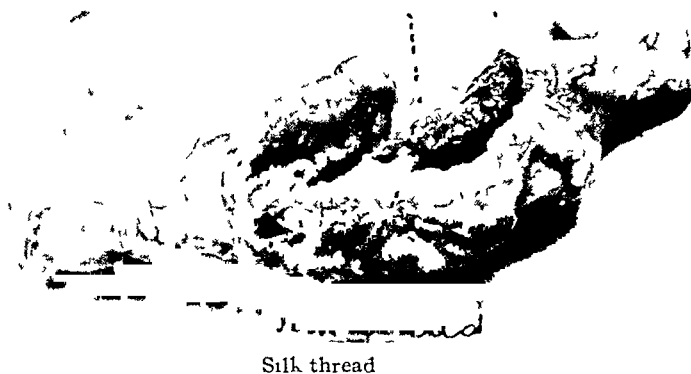
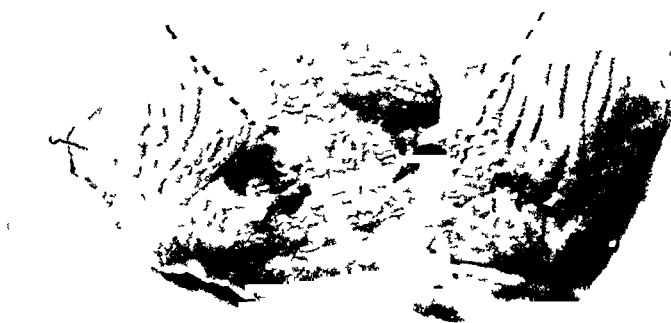


FIG 8

Two small calculi formed around silk thread



SECONDARY ULCERS OF STOMACH AND JEJUNUM

Unabsorbable material, linen and silk, was used in 14 cases of side-to-side intestinal anastomosis. After periods of three to ten months the dogs were sacrificed, the thread had been eliminated in two cases and in three of the remaining twelve the thread had been the nucleus for the formation of calculi (Figs 7 and 8). In the specimen in Fig 7 the size of the calculus was about more than half the lumen of the intestine, the dog had been operated on nine months before the autopsy and was apparently in good health.

To the author it seems to be of clinical importance the fact that in patients, who suffer after operations requiring intestinal anastomosis, in which unabsorbable material had been used, the later symptoms might be due to the formation of calculi the nucleus of which has been the thread hanging loose in the intestinal cavity. That some of these patients get well after a certain period might be explained by the fact that strong peristaltic movements might later eliminate the calculi with the thread.

The same conclusions reached in the study of gastrojejunal anastomoses seem to the author to be applicable to the intestinal anastomosis, that is, that only catgut should always be used for the through-and-through suture and fine silk be reserved for the seroserosal suture.

CLINICAL ASPECTS OF COLON STASIS

By JOSEPH RILUS EASTMAN, M D

OF INDIANAPOLIS, INDIANA

THE extraordinary impetus given to the study of intestinal stasis by the work of Sir Albuthnot Lane has brought out on every hand reports of clinical, laboratory and rontgenologic observations with expressions of opinion of the most divergent character

Mr Lane alludes to the colon as the cesspool of our gastro-intestinal drainage scheme, to which Mr Gray of Aberdeen rejoins that he regards it a slur on the Creator to speak of the cæcum as a cesspool, and Guillot of Havre says that to refer to the cæcum as a *fosse d'aisance* is nothing less than a gratuitous insult to an important part of the digestive tube. This ardent defence is of course wasted upon those who, like Metchnikoff and Barclay Smith, dispute any justification for the existence of the colon.

It will be recalled that Lane in his remarkable brochure, "The Consequences and Treatment of Alimentary Toxæmia," supported his views with the radical theses of Professors Metchnikoff, of Paris, and Barclay Smith, of Cambridge, the former stating, "It is no longer rash to say that not only the rudimentary appendix and the cæcum but the whole of the large intestine are superfluous and their removal would be attended with happy results," and the latter declaring that "the large intestine is practically a useless encumbrance."

The colon is, as is well known, often demonstrably the seat of stagnation of decomposing matter ridden with many and various bacteria, both dead and alive. However, it is important to note that such stagnation does not always cause alimentary toxæmia, the symptoms of toxæmia appearing, as emphasized by Case, when the vital defensive processes of the body are unable to destroy or eliminate by vicarious avenues the products of intestinal putrefaction.

There are, perhaps, few who in our present understanding will admit that the simple circumstance of the simultaneous presence of the *Staphylococcus citreus* in an infected joint and in the colon justifies removal of the latter organ for the cure of arthritis or that it is quite safe to leave a gall-bladder filled with stones as of little import while a complete colectomy is done for constipation, or that tuberculosis of the carpus is best treated by ablation of the large bowel, nor will they readily give up thyroidectomy or other surgery applied to the thyroid

gland in Graves's disease, and yet practically all surgeons acknowledge the greatness of the influence of Lane upon the study of colon stasis and subscribe in a general way to his views

It matters little whether the process of extension of disease from the stagnant colon is that of auto-intoxication as described by Amussat, Humbert, and Bouchard, or whether it be that of subinfection as contended by Adam, one fact abides and that is that alimentary toxæmia is a reality and, moreover, its consequences as claimed by Lane are serious

It is unfortunate that the distinction between constipation, intestinal stasis and alimentary toxæmia is not more clear. Constipation, according to Guillot, and many others, applies only to the sojourn of the fæces in the descending iliac and pelvic colons. Lane, with whom the term intestinal stasis originated, defines it as "Such abnormal delay in the passage of the intestinal contents through a portion or portions of the intestinal tract as results in the absorption into the circulation of a greater quantity of toxic or poisonous materials than can be treated effectually by the organs whose function it is to change them into products as innocuous as possible to the tissues of the body." Thus, from Lane's definition it appears that constipation may become colon stasis if auto-intoxication supervenes. This definition is obviously in no sense in conflict with the established belief that stagnation of intestinal contents may exist even for a long period without harmful alimentary toxæmia. It does seem somewhat arbitrary, however, to restrict the term stasis to conditions of stagnation with symptoms of toxæmia. Ought we not in the interest of clarity to make more frequent use of the expression, intestinal toxæmia, its meaning being manifest?

For practical purposes it is well to keep in mind a somewhat arbitrary division of intestinal stasis into two clinical varieties, the first amenable to medical or non-surgical treatment and the second amenable only to operation in some form. The first may be designated as functional, the second organic.

Mr Lane, it seems, regards a rather large proportion of cases of intestinal stasis as surgical ones, and in operation if the colon comes up freely on a long mesentery and can be removed easily he takes it out, if not, an end-to-side ileosigmoidostomy is made. It is probable that most surgeons at present, however, prefer to reserve operation for those cases in which the colon is hampered or constricted by membranes and bands, extensively fettered by fixation adhesions or seriously deformed by gravitation or kinks. That is, it is preferred by them to operate only in cases of demonstrably organic stasis.

The relation of colitis to stasis and peri-intestinal adhesions and membranes is of noteworthy clinical interest. In cases of well-defined colon stasis, I have not failed to find an associated chronic colitis. Recently I had the privilege of a personal conversation with Prof Arthur Keith of the Royal College of Surgeons upon this subject. Prof Keith, who in the course of original work of great significance on the functions of the large bowel has examined microscopically a considerable number of colons removed by Sir Arbuthnot Lane for colon stasis, remarked that he found evidence of chronic colitis in two cases only. Many of those who have studied colon stasis from a clinical viewpoint will look upon the findings of Prof Keith as surprising. Chronic colitis in some degree has been recognized in many cases of well-defined colon stasis with pericolic adhesions and coloptosis. The chronic colitis was evidenced upon microscopic examination by the presence of plasmacytes with eccentrically placed nuclei, overdistended goblet-cells, congested blood-vessels and round-cell infiltration.

It is possible that the reason for the comparative infrequency of colitis in the resected colons of Mr Lane may be sought in the circumstance that Mr Lane, giving a rather wide field of application to colectomy and ileosigmoidostomy, operates occasionally in stasis of a degree so mild that a less intrepid and less skilful surgeon might exclude it from the catalogue of surgical conditions.

In many cases of marked colon stasis the macroscopic appearance of the mucous membrane of the colon is apparently alone sufficient to justify a diagnosis of chronic colitis, that is, redness, induration, ulceration and the presence of excessive mucus could, it seems, hardly be misinterpreted.

Many writers upon this subject speak of the association of chronic colitis with stasis. E. Payr at the German Congress for Internal Medicine for 1910 described the manner in which coloptosis and stasis induce colitis, even to the stage of ulceration. He notes that as the result of long retention of colon contents decubitus ulcers appear.

An inflammation of the mucous membrane with profuse secretion is looked upon by K. von Noorden (*Zeitschrift für klin. Med.*, Bd 76) and Payr as a quite natural result of hyperkinetic constipation. The hyper-physiologic contractions of the colon musculature lead to hypertrophy. The mucosa is infiltrated with round-cells and polyblasts, in addition the serosa is torn and irritated by high-grade localized distention leading to what Payr calls fixation adhesions. Occasionally the local ulcerative process leads to an active general colitis so that extensive areas of the colon mucous membrane are ulcerated. This process

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Payr has demonstrated by roentgenograms. It need hardly be stated that the serosa will respond to the deep ulceration of the mucous membrane with an exudative inflammation leading to the formation of cicatricial strictures and of pericolic membranes and bands.

I have produced in rabbits a colon stasis by prolonged intermittent ligation of the anus, and such an artificially induced colon stasis resulted in colitis and after a few weeks in the formation of plastic peritoneal adhesions which were drawn out into membrane form by the normal movements of the large intestine.

Virchow as early as 1853 observed that the accumulation of faeces in the caecum and the ascending colon caused colitis and chronic peritonitis, which in turn produced a mechanical obstruction to the passage of faeces.

Stasis may lead to colitis. Colitis may become ulcerative and invoke a plastic peritonitis with extensive adhesion formation or "zygosis," as a similar process often observed in the foetus has been designated by Prof. Keith. Plastic peritonitis with constricting bands and fixation adhesions arrests the procession of colon contents. Overloading causes ptosis, and ptosis, for example, implicating the colon transversum, brings about stasis.

Prof. Keith also remarked in personal conversation as noted above that he had been unable to discover by the examination of Mr. Lane's cases any direct evidence that pericolic membranes had induced stasis. This observation by so eminent an authority is of much interest since it is apparently in conflict with the observations of many others. It is possible that Keith, examining Mr. Lane's specimens, found relatively few cases of extensive fixation adhesions in the sense of Payr. It is of course not meant to imply that Prof. Keith drew from the observations mentioned the general deduction that pericolic membranes rarely produce stasis. Certainly permanent fettering and fixation of the colon cannot but lead to stagnation.

Mollisson and Cameron and Herz, having observed pericolic adhesions and pericaecal membranes, frequently in adults and occasionally in young infants unassociated with constipation, conclude that such pericolic bands can be neither the cause nor the effect of constipation. It is of course clear that adhesions or membranes which neither constrict the colon nor hamper its movements are harmless and of no importance, however, extensive fixation adhesions in the sense of Payr are surely fraught with harmful possibilities. It seems safe to assume for the purpose of clinical study that any one of the four elements, stasis,

colitis, adhesions or ptosis, may be caused by any or all of the other three Temporary downward displacement of the transverse colon, as shown on a single skiagram, may of course be quite normal and bear no relation to stasis Pendulum-like swinging of the mid-colon from its fixed extremities as well as cephalad and caudad movements may lead into error anyone who, depending on skiagrams, omits a prolonged screen examination (Case)

Rovsing (Thorkild Rovsing, *Gastrocoloptosis*) remarks concerning the intimate association of the factors of ptosis and stasis, that "in the moment when gastropptosis appears there comes on, *eo ipso*, a ptosis of the colon transvesum, this segment of the colon sinking downward as far as the length of the mesocolon permits so that the transverse colon hangs like a garland between the fixed extremities, the *curvatura hepatica* on the one side and the *curvatura lienalis* on the other, gradually forming a more acute angle as the process of sinking continues The result is that a condition of obstipation develops with a stagnation of heavy and hard fecal masses "

Von Noorden and Payr have made clear how such hard and heavy masses may produce ulcerative colitis and Virchow many years ago noted that colitis may invoke a localized or general peritonitis with plastic adhesions Thus, we have the "circulus vitiosus "

It seems clear that intelligent treatment of any or all of these factors must be based on an understanding of this mutual relationship

Treatment directed at the relief of chronic colitis will by virtue of the relationship shown above affect also the ptosis and stasis and likewise the associated plastic peritonitis

Properly performed short-circuiting operations by the improved drainage which they provide or should provide doubtless relieve chronic colitis and indirectly affect favorably the other factors of stasis, ptosis, and peritonitis It is well known that the fæces are to a considerable extent made up of epithelial debris, of intestinal secretions, and of dead and living bacteria and that these things mixed with food residue under the influence of contractions of the cæcum rise in the ascending colon But this contraction is not constant The empty cæcum is in repose, it does not contract It is awakened to contraction only when the small intestine empties into it its liquid contents It is this irritant which provokes the contractions (W J Mayo) If contractions are not produced in this way, the fæces composed of epithelial debris, mucus and bacteria have no tendency to be evacuated The colon becomes atonic and incompetent and obstipation is increased by antiperistalsis It is for this reason that ileosigmoidostomy may be said to be falsely conceived By

this operation the liquid contents of the small intestine are not permitted to enter the cæcum to bring about contraction. It is perhaps for this reason that Lane, Leriche and others have been obliged to re-operate after ileosigmoidostomy and deal with an enormous fecal accumulation in the cæcum and ascending colon. Typhlosigmoidostomy or typhloproc-tostomy, however imperfect they may be, cannot fail for the reason noted above, for in these operations the fluid contents of the small intestine are permitted to enter the cæcum.

In cases of simple constipation concerning only the left colon, ileo-sigmoidostomy may be of lasting benefit, but it is debatable whether such a condition is not better treated by non-surgical means.

If the caput coli be anastomosed freely to the sigmoid or rectum at the lowest point possible without traction, then the reversed peristalsis of the ascending colon will favor drainage of the cæcum through the artificial opening in the floor of the pouch, which is the chief habitat of the ammoniacal food and intestinal bacteria of decomposition.

The improvement following short-circuiting operations is probably due in some measure to the relief of colitis with consequent relief of the associated factors mentioned previously. Direct drainage by allowing escape of bacteria-laden secretions leads to improvement in the colitis with consequent increase of propulsive power and proportionate decrease of stasis. This is a probability in stasis cases in which the colon is not completely fettered by firm adhesions. Unless the colon is thus hopelessly enveloped in dense membranes, the purpose of a well-planned short-circuiting operation aimed at complete exclusion of the colon should be, not by the complete exclusion to put the colon out of commission, but by relief of colitis, pericolitis and ptosis through drainage and rest to put the colon back in commission. If the stasis really concerns the cæcum and ascending colon, this cannot be accomplished by diverting the contents of the ileum into the rectum. The liquid contents of the ileum should still be emptied into the cæcum because of their ability to stimulate contraction.

Writing of ileotransversostomy, Oppel (*ANNALS OF SURGERY*, October, 1914) remarks that "after a complete unilateral exclusion, no matter whether such exclusion was effected by means of a communication between the ileum and the transverse colon, or by means of ileosigmoidostomy, the part of the colon thus excluded forms a cul-de-sac which accordingly varies in length. It also appears that this sac can by means of retrograde peristaltic movement fill up with feces and thus cause serious trouble."

Grekoﬀ (quoted by Oppel) has mentioned a case in which an ac-

cumulation of fæces in the cæcum after an exclusion led to a perforation, and caused the death of the patient

DeQuervain, "in consequence of an accumulation of fæces, had twice to resect the cæcum and the ascending colon, following an anastomosis between the ileum and transverse colon, and Franké, formerly an ardent advocate of ileosigmoidostomy, has lately begun to talk about the dangers of antiperistaltic movements of the large intestine "

Quite recently Von Beck stated that "out of his thirty-two cases which underwent ileosigmoidostomy owing to chronic colitis, pericollitis, and also owing to an unsatisfactory position of the large intestine, six cases, in the course of time, developed intestinal stasis in the excluded cul-de-sac "

J T Case and Hamilton Drummond separately made rontgenograms of patients after ileocolostomy and found a definite dilatation of the terminal ileum. The loop of ileum between the anastomosis and the cæcum seemed to have taken over to some extent the function of the colon

It need hardly be said that the operation of typhloproctostomy removes in an anatomic sense at least one cul-de-sac, the cæcum

It has been noted repeatedly that when the cæcum is joined to the sigmoid much of the food passing from the ileum into the cæcum ascends the right colon. My first rontgenograms were made after such operations for stasis without extensive adhesions while the patient was still in the hospital. They revealed that the bismuth column did not pass from the cæcum through the anastomosis opening. Rontgenograms, made twelve hours after the bismuth meal was taken, showed the cæcum filled with bismuth, and subsequent examinations showed the bismuth column rising to the hepatic flexure. A week later, or three weeks after operation, rontgenograms showed that the bismuth column after reaching the cæcum passed partly through the anastomosis opening, though the greater part arose in the ascending colon as before. In cases with more extensive adhesion formation the proportion of colon contents passing through the stoma was greater.

It is Oppel's belief (*vide supra*) that if the cæcum be anastomosed to the sigmoid in a case of incompetent or obstructed colon transversum, the contents of the ileum after passing Bauhin's valve will not pass through the stoma in its entirety but part will go up the ascending colon till it meets the obstruction in the transverse colon, and that part

which escapes from the cæcum through the stoma into the sigmoid will not pass down into the rectum as desired but will be regurgitated upward in the colon descendens and not stop until it meets the obstruction in the transverse colon. In this manner, he says, two new cul-de-sacs for stagnant food are formed, one on each side of the obstruction. I think this is somewhat inconstant. Seven of my cases skiagraphed after typhloproctostomy have not revealed this unfortunate condition.

Bergmann first anastomosed the cæcum to the sigmoid for volvulus of the ascending colon, and the operation in cases of stasis is hardly indicated unless membranes or adhesions so fetter the colon as to make such an exclusion necessary because of incompetency or obstruction. If the colon is obstructed at the hepatic or splenic angles alone, then colocolostomy, as practised by Payr, which excludes these flexures alone, is of obvious usefulness. Redundant sigmoid may be treated by the Trojanoff-Winiwarter anastomosis between the loops of the sigmoid or eventually the redundant colon may be resected. At any rate, after typhloproctostomy, coils of redundant sigmoid cannot with safety be left above the stoma. If axial torsion does not occur it is unlikely that a stoma between the caput coli and lower sigmoid or upper rectum will interfere with the discharge of the fæces *per vias naturales* unless the opening be so large and lax as to permit of vicious valve formation or there are coils of redundant sigmoid above the stoma, in which instances it is conceivable that a large proportion of the fæces might pass in the wrong direction through the stoma. It is not clear that Montprofit's operation of dividing the terminal ileum and anastomosing both end-to-side with the sigmoid represents an improvement over simple typhloproctostomy. Here an attempt is made to drain the excluded cæcum in defiance of the ileocæcal valve through the short stump of the ileum, whereas, this drainage of the cæcum can be accomplished more simply and more completely by a large stoma in the floor of the cæcum.

It is probable that time will demonstrate the fatuousness of either short-circuiting or resection operations in cases of stasis, not presenting demonstrable obstructing factors.

Notwithstanding the brilliant results attained by surgery since Mansell Moullin in 1900 made an ileosigmoidostomy for stasis, it is worthy of repetition that many cases of stasis, for example those having their origin in chronic colitis, can be relieved without operation, and unless peritonitis causing fixation adhesions is present with compressing membranes and bands, there is a likelihood of relieving ptosis and stasis by non-surgical means, such as prolonged use of petrolatum,

abandonment of girdles and corsets and correct standing and sitting posture with chest forward and abdominal muscles taut so that the abdominal viscera are held upon the shelf made by the declivity of the ileopsoas muscle and the fat of the loins, as remarked by F H Martin, Goldthwaite and Robert C Coffey

One of Sir Arbuthnot Lane's laconicisms relates to the abuse of physical exercise "The professional athletes," he says, "are all toothless at forty" We do not take this to imply that proper exercise, for example horseback riding with attendant visceral succussion, is without value in stasis

THE RONTGENOLOGIC FINDINGS IN THREE CASES OF DIVERTICULITIS OF THE LARGE BOWEL

BY R. D. CARMAN, M.D.

OF ROCHESTER, MINN

(From the Mayo Clinic)

ACCORDING to McGrath,¹ Graser in 1899 was the first to demonstrate the association of acquired diverticula with "isolated circumscribed adhesive peritonitis" on the colon, which had been mentioned by Virchow in 1853. Although not of common occurrence as compared with other lesions of the large bowel, diverticulitis nevertheless is met with sufficiently often to require its consideration in many cases with symptoms referable to the colon. Thus as early as 1907, Mayo, Wilson and Giffin² were able to report five cases operated on in the Mayo Clinic, and in 1912 Giffin³ collected twenty-seven such cases, in seventeen of which there was involvement of the sigmoid. Giffin has discussed the symptomatology and only the salient features require mention here.

The proportion of males to females appears to be two or three to one. An inclination to obesity is noted almost without exception, the patients are of sound flesh with good color and, where loss of weight occurs, it is only slight. Abdominal pain, usually of considerable severity, is the rule. Often the patient is able to localize the pain to the sigmoid or descending colon. Constipation is complained of by the majority and is often of more than moderate severity. Vesical symptoms, such as frequency and tenesmus, are occasionally noted. In every instance of diverticulitis of the sigmoid, a mass was felt in the left lower quadrant or in the pelvis. The proctoscopic examination has been negative, save in one case, where the tumor had become partially intussuscepted into the rectum. Absence of blood from the stools is notable, and this is explained by the fact pointed out by Wilson,² that the inflammatory process is primarily extramucosal, and that the condition is really a peridiverticulitis.

Given a case with such symptoms, the differential diagnosis becomes a matter of some importance. One condition which must be eliminated is that of left-sided appendicitis. Here the rontgenologic examination would be decisive by showing the position of the cæcum. The most difficult differentiation is from carcinoma. While the symptoms are

not quite typical of carcinoma, they do not absolutely contradict it. Indeed, Wilson⁴ has shown that carcinoma may develop within the diverticula. The question arises as to what can be expected from the X-ray.

McGrath,¹ in his very complete review of the pathology, has brought out the following facts. Nearly all these diverticula are of the "false" type, that is to say, they are hernia of the mucosa through the muscularis, commonly at points where the latter is penetrated by vessels. The chief causes are weakness of the muscularis with an increase of intra-intestinal pressure, such as occurs in stasis and gas formation. Diverticula vary in size from that of a pea to a hen's egg. They are usually round or ovoid, and most often sessile, though occasionally pedunculated. The opening into the bowel may be narrow and practically stenosed, or it may be almost as wide as the diverticular cavity. Except those in the small intestine, the sacs usually contain fecal matter and sometimes fecaliths. Histologically, the sac wall is made up of mucosa, submucosa and serosa, the muscularis being slight or wanting. The mucosa may be slightly atrophic or even ulcerated, but the most constant pathologic process is the chronic, proliferative, extramucosal inflammation, the "peridiverticulitis" of Wilson, with round-cell infiltration which results in mass formation.

Over a year ago I examined the fixed and somewhat shrunken pathologic specimens of diverticulitis at St. Mary's Hospital with regard to the possibilities of roentgenologic diagnosis of the condition. A cursory inspection of this material gave me the impression that the demonstration by the X-ray of the diverticula themselves was almost, if not quite, hopeless. The vast majority of them were far too small to be visualized even if their filling with opaque material could be assured. The few larger ones, if capable of being filled at all, were, I thought, likely to contain fecaliths or fecal material which would prevent the entrance of the opaque enema. The net conclusion was that a filling defect could in many instances be demonstrated, but that this could not be distinguished roentgenologically from a filling defect due to carcinoma. I still held this view when the three following cases came up for examination.

CASE I (99,640) —Male, aged fifty-five, physician. Examined January 26, 1914. Family and personal history negative.

Previous Diseases —Gall-stones (passed one), severe cholecystitis and peritonitis fifteen years ago.

Former Operations —Twelve years ago he was operated on for left inguinal hernia and hemorrhoids.

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Clinical History—Post-operative abscess following above operation with symptoms of cystitis. The abscess developed around the ligature later, which was passed by urethra. Since then the patient has had symptoms of bowel obstruction, the last time in December, 1913, one attack five years prior to this. There were left-sided griping and gas pains with much distention. At one time the bowels did not move for eight days, ordinarily, however, they move regularly. Apparent lump and soreness in left iliac fossa with pressure affecting the bladder. Pencil stools before last attack. The patient returned to his home and, prior to his operation, March 17, 1914, suffered several obstructive attacks, with flatulence, rumbling and stinging pain over the pubis and left side during bowel movement. Sensation of "something pushing up from rectum" when in sitting posture. Some weight fluctuation but the greatest loss at any one time was twelve pounds. Urine negative. No record of examination of blood or feces.

Rontgen Examination (Fig 1)—January 27, 1914, patient was examined in the routine way by barium enema. Rontgenograms showed an irregular filling defect with marked narrowing in the sigmoid. Small barium shadows were observed outside the lumen of the bowel, an appearance quite unusual, and at that time inexplicable. From the clinical facts and the Rontgen appearance W J Mayo suggested to the patient that the condition might be diverticulitis.

Operation—March 17, 1914, first stage of Mikulicz for tumor of sigmoid (diverticulitis, inflammatory). Bowel exceedingly thick and adherent to pelvic wall posteriorly, about fourteen inches of bowel involved. Subsequent stages performed on March 24, April 4 and April 24.

Pathological Report—Tissue removed, sigmoid. Diagnosis diverticulitis.

The patient made a good recovery, has taken on considerable weight and is carrying on his accustomed work.

CASE II (105,595)—Male, aged fifty-one, merchant. Examined May 7, 1914. Family and personal history negative. Denies any previous disease.

Former Operation—Appendectomy elsewhere, without any exploration.

Clinical History—For ten years he has been constipated. In the past two years he has noticed a sore lump in the left lower abdomen which has been associated with an increase of constipation. On two occasions this lump became swollen and very tender. In December, 1913, he had a chill with fever, and griping pain with gas, marked swelling and soreness at the spot complained

of Recent similar attack four days ago Stools small and tapered, necessitating laxatives, but no blood or pus noted When the lump is swollen, the patient has frequent urination with some pain General health good Weight loss five pounds

Physical Examination—Tenderness and resistance in lower left abdomen Rounded elongated mass felt by bimanual examination Rectum seems negative aside from small hemorrhoids

Proctoscopic Examination—Negative

Rontgen Findings (Fig 2)—Negative save for slight enlargement of cæcum At the same time small shadows were noted outside the sigmoid lumen, but their significance was not at that time appreciated

Operation—May 13, 1914, first stage Mikulicz by C H Mayo Diverticulitis of sigmoid Subsequent stages May 19, June 2 and 23

Pathological Report—Tissue removed, sigmoid Diagnosis: diverticulitis

This patient made a complete recovery and has had no trouble since

CASE III (114,002)—Male, aged fifty-four, merchant Examined August 28, 1914 Family and personal history negative

Clinical History—Attacks of pain and tenderness in left iliac fossa Illness began as a diarrhoea, lasting several months He has recently noticed that a full bladder causes a sensation of pressure During the past eight months he has had indefinite gastric symptoms with vague discomfort after meals He is gradually losing weight and strength

Rontgen Findings—The rontgenogram (Fig 3) shows a fairly normal colon save for insufficiency of the ileocæcal valve and some extraluminal shadows along the inner aspect of the descending colon This patient has not yet been operated on

In the first case, particular attention was given to the rontgenograms These showed the filling defect of an organic lesion in the sigmoid and, although the history suggested a benign inflammatory lesion, carcinoma was nevertheless considered probable from the X-ray stand-point The shadows noted outside the sigmoidal lumen could not then be accounted for In the second case, these same shadows were seen but no filling defect was observed and no interpretation was attempted When operation showed the existence of a diverticulitis in this case also, the plates of both cases were brought out and compared, and the presence of extraluminal shadows in both began to take on considerable significance Still hampered by the preconceived idea that diverticula could seldom or not at all be visualized, I sought some other explanation of these



FIG 1 —99640 Rontgenogram of barium-filled colon (enema), showing marked filling defect in sigmoid with ext-alumenal shadows (diverticula) at A



FIG 2 —105595 Shows barium-filled colon (by enema) with extraluminal shadow (diverticula) at A



FIG 3—114002 Colon filled with bariumized enema Diverticula at A

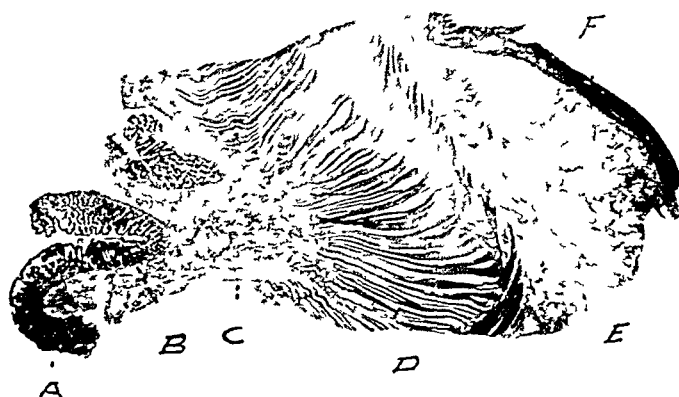


FIG 4—99640 Cross-section of wall of normal sigmoid photomicrograph magnified four times showing normal mucosal fold. Note that this fold does not penetrate the musculature. A, mucosa, B mucosal fold, C submucosa, D musculature, E subperitoneal fat, F peritoneum

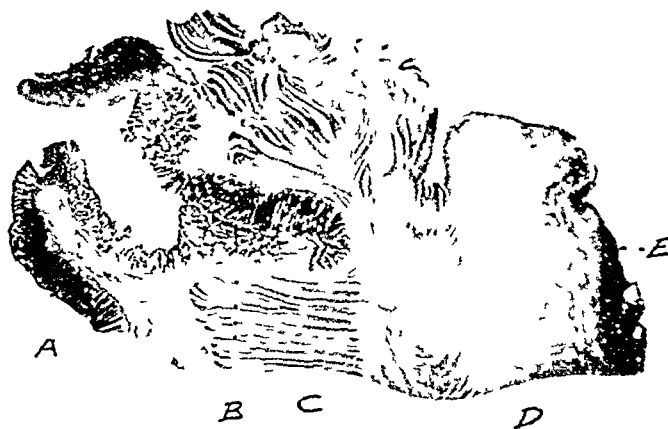


FIG 5—99640 Cross-section of wall of sigmoid photomicrograph magnified four times Shows mucosal fold and submucosa separating the circular muscular fibres and penetrating to the longitudinal musculature An early diverticulum of this type can hardly be demonstrated radiologically because of the absence of flask-like dilatation 1 mucosa, B diverticulum C, circular muscle fibres, D subperitoneal fat, E peritoneum

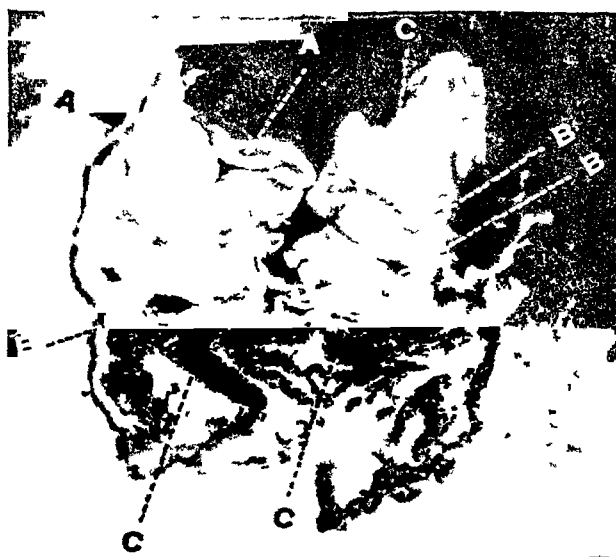


FIG 6—99640 Longitudinal section through sigmoid showing multiple diverticula with marked thickening of intestinal wall and narrowing of lumen 1 mucosa B diverticulum containing fecaliths, C canal leading to diverticular sac

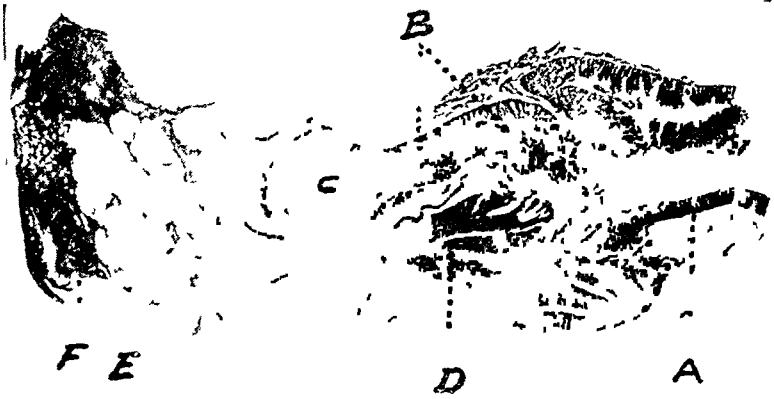


FIG 7—99640 Cross section of wall of sigmoid photomicrograph magnified four times Deep-seated late-stage diverticulum with flask-like ampulla The diverticulum has separated the circular fibres which are here seen compressing the neck passed through the longitudinal bands of muscle and penetrated into the subperitoneal fat This advanced type offers the greatest opportunity of radiologic demonstration because of its capacity and the distance from the intestinal lumen A, mucosa of bowel, B canal leading into diverticular cavity at C, D musculature, E subperitoneal fat, F, thickened peritoneum

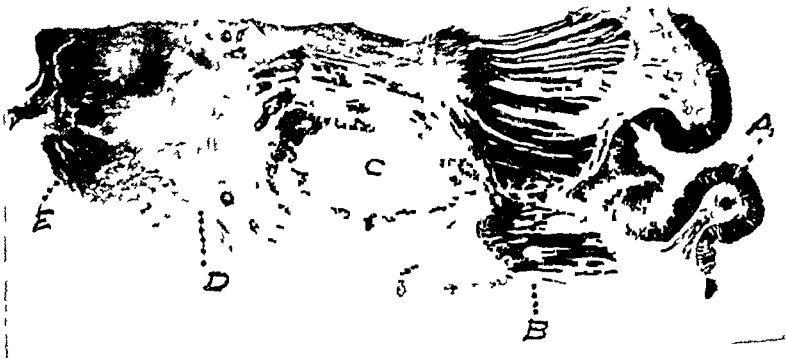


FIG 8—105595 Cross-section of diverticulum, photomicrograph magnified four times A, mucosa of sigmoid, B neck of diverticulum (not well shown on account of depth at which section was cut) extending from lumen of sigmoid through circular muscular fibres to diverticular sac at C D subperitoneal tissue, E peritoneum Note that mucosal lining of the diverticulum is like that of the sigmoid and it differs in this respect from the inflammatory pockets produced by perforating ulcer of the stomach which are often but wrongly spoken of as diverticula

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shadows A colleague having suggested that they might be due calcareous deposits, I secured the specimens, examined them, and present the results herewith

Sections of the tissue removed from Cases I and II (Figs 4-8) here illustrated show the customary pathologic changes The diverticula of varying size have herniated through or partially through the muscularis and lie within the greatly thickened subperitoneal tissue Some of them contain fecaliths, others are empty No calcareous infiltrations are anywhere present The extraluminal shadows in the roentgenogram which are plainly shadows of barium, correspond in contour and situation to the larger diverticula

Notwithstanding the fact that sigmoidal diverticula are commonly filled with fecal material, it is evident from the two cases herewith shown that the sacs are not always thus filled or may, at least in some instances, be emptied by purgation and a cleansing enema and, if of sufficient size, may be filled with an opaque clyisma and be visualized on the Rontgen ray When thus seen, they appear as oval or round barium shadows just outside the intestinal lumen, and this appearance would seem to have high diagnostic value in differentiating the condition from carcinoma While a carcinoma might show more or less apparent pocketing due to degenerative changes, such pockets would not have the rounded symmetry of diverticula In the case of carcinoma supervening upon diverticulitis, which sometimes happens, if extraluminal shadows were present the roentgenologic appearances would be those of diverticulitis, while if these shadows were not present, the condition would be regarded as one of carcinoma

To be borne in mind is the possibility that by reason of a stenotic inlet, or extremely small size of the diverticula, or by their containing fecal matter, they may fail to fill with the clyisma In this event there would be seen only a filling defect proportional to the extent of inflammatory thickening and not distinguishable roentgenologically from that of carcinoma As to the chance of a fecalith being seen, that would depend upon its size, density and situation It is also quite possible that sufficient barium may enter a diverticulum containing a fecalith to make the sac visible

Phleboliths or calcified glands may give shadows resembling those of barium-filled diverticular pockets If in the region of the upper sigmoid, palpation during the screen examination may show that a phlebolith or gland-shadow has no relation to the bowel, while that of a diverticulum moves with it If situated near the lower sigmoid, which cannot be shifted about by palpation, the distinction could not be the

made Hence a screen or plate examination before administering the enema might be an advisable routine to eliminate the possibility of phleboliths or calcified glands in this region

Since diverticula tend to occur near the mesenteric border of the bowel, in the neighborhood of the vessel entrances, they are usually best seen in the anteroposterior view But they may occur in other situations and, if on the anterior or posterior wall, may be obliterated in the shadow of the bowel as seen in the anteroposterior view For this reason, both the screen and plate examination should be made at various angles of observation, and stereoscopic rontgenograms made when possible

The opaque ingested meal offers less chance than the enema of detecting diverticula, since the former scatters more or less irregularly through the bowel, the contour of the lumen is not well shown, and small detached masses of barium can hardly be differentiated from diverticula The liquid enema, introduced under some pressure, is also more likely to fill diverticula than is the meal

The rarity of rontgenologic findings in this condition can be understood from the fact that, so far as I can learn, only one case has hitherto been reported (Abbe⁵), the rontgenologic work being done by Le Wald It is also worthy of note that a monograph published this year by G Schwartz,⁶ of Vienna, on the Rontgen diagnosis of the colon makes no mention of diverticulitis

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TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY

*Stated Meeting, Held at the New York Academy of Medicine,
November 25, 1914*

The President, DR FREDERIC KAMMERER, in the Chair

TRANSFUSION AND SPLENECTOMY FOR VON JAKSCH'S ANÆMIA IN AN INFANT

DR EUGENE H POOL presented a male infant who was admitted to the service of Dr W R Williams at the New York Hospital on July 22, 1914. The child was then eight months old. It was a seven-months baby, born cyanotic and had been breast fed up to the age of four months. Since then he had ceased to gain in weight. The bowels were constipated. The child was restless and fretful and perspired a good deal, especially on the top of the head. He had had broncho-pneumonia twice, the first time at the age of four months, the second time two months later. The family history was negative.

When admitted to the hospital, the baby was very poorly developed and nourished, presenting evidences of anæmia and rhachitis. The edge of the liver could be felt 2 cm below the costal margin in the right parasternal line, and the edge of the spleen was felt 5 cm below the costal margin in the left mammary line. The Wassermann reaction was negative.

Repeated examinations of the blood gave the following results. The red blood cells ranged between 1,400,000 and 2,400,000, the white cells between 17,000 and 54,000, the hæmoglobin from 30 per cent to 45 per cent. The differential count varied only slightly during the first month of the patient's stay in the hospital. A typical count was as follows: Polynuclears, 35 per cent, eosinophiles, 2 per cent, lymphocytes, 49 per cent, transitionals, 3 per cent, large mononuclears, 6 per cent, myelocytes, 5 per cent. Nucleated red cells were constantly present, ranging from six to sixty-six per hundred white cells. Of these, there was an average of from two to three megaloblasts.

The diagnosis of von Jaksch's anæmia was ultimately made by Dr Williams, who treated the child for six weeks, but his condition became progressively worse. He was very feeble, and it was decided

that splenectomy offered the only hope of improvement. Two days before operation the red cells numbered 1,660,000, the white cells 54,000, with 37 per cent of hæmoglobin.

On August 17 Dr Pool did a transfusion by the Lindemann method, 150 cc of blood from the father being introduced into the internal saphenous vein of the child. The latter was then etherized by the drop method and a three and a half inch incision was made through the left rectus and splenectomy performed. The wound was closed without drainage. The operative recovery was uneventful and the child's condition improved markedly for a time, but at present it was not as good as a month ago, although much better than before the operation.

The spleen was examined by Dr W J Elser, who reported as follows

The specimen consists of a spleen measuring 10 x 7 x 4 cm, and weighing three and a half ounces. The organ is normal in shape and fairly firm in consistence, with a smooth surface, bluish-gray in color. The capsule is of normal thickness. The tissue, on section, is smooth and pale, grayish-red in color. The Malpighian bodies are few in number and extremely small and indistinct. The trabeculæ are not prominent. Microscopic examination shows the lesions attending the symptom-complex of so-called von Jaksch's anæmia. The most striking features of the sections are myeloidization of the pulp and atrophy of the Malpighian bodies.

The following report on the blood condition and its relation to the diagnosis of von Jaksch's anæmia was made for Dr Pool by Dr Ralph Stillman of the New York Hospital. "Following the operation, the red cells increased to 4,200,000, and the hæmoglobin to over 85 per cent. The number of white cells dropped gradually but steadily to 13,300. The differential count, however, showed essentially the same picture as before the operation. For example, here is a count made sixty days after the splenectomy: Polynuclear neutrophiles 16.0 per cent, polynuclear eosinophiles 1.0 per cent, polynuclear basophiles 0.25 per cent, lymphocytes 52.0 per cent, transitionals 4.0 per cent, large mononuclears 1.0 per cent, myelocytes 3.25 per cent, degenerated cells 22.5 per cent, normoblasts 14 per cent, megaloblasts 4 per 100 white cells.

There was a decided increase in the reticulated cells as demonstrated by the "vital" stain. The color index has varied from 0.9 to 1.1.

Anæmia pseudoleukæmia infantum (Jaksch-Hayem) is a condition described as occurring in infants and characterized by marked anæmia, enlargement of the liver and spleen, and a characteristic blood picture. The spleen exhibits a myeloid metaplasia which may be very marked.

CARCINOMA OF BREAST

The blood shows a reduction both in the red cells and hæmoglobin, and the constant presence of nucleated red cells. The white cells are increased in number and may vary greatly, as in this case, where they jumped from 17,000 to 54,000 in two weeks, and then dropped to 19,000 during the next three days. The differential count is also subject to variations in the relative percentages of the polynuclears and the lymphocytes. Myelocytes are constantly present, though usually in small numbers. An especially important fact is that the blood picture remains essentially unchanged for months and years.

While this condition is usually described in the text-books along with pernicious anæmia or in close relation to it, it may better be classified as a variant of secondary anæmia. Its not infrequent association with rickets has led some to insist that the blood condition is merely one of the symptoms of the disease, but it has often been reported as occurring in the absence of any symptoms of rickets, and it seems much more rational to consider rickets as but one of the causes of the pseudo-leukæmic anæmia of infants. It is possible, of course, to get such a picture as is seen in this case in leukæmia, but aside from the fact that myelogenous leukæmia is an exceedingly rare and rapidly fatal disease at this age (eight months), such a blood picture would be only temporary and would soon change to that of the typical leukæmic blood count. This patient was in the hospital for about three months, during which time very frequent blood examinations were made, and at no time was the count typical or even suggestive of leukæmia.

CARCINOMA ORIGINATING WITHIN AN ADENOFIBROMA OF THE BREAST

DR POOL presented a woman, forty-seven years old, who was admitted to the New York Hospital on July 8, 1914. One month before her admission she noticed a lump in her right breast. She was married, but had had no children nor miscarriages, and her menstrual history was regular. The patient was a well-developed and well-nourished woman.

In the upper right quadrant of the right breast there was a hard, slightly tender mass, about two and a half to three inches in diameter, it was sharply circumscribed, slightly nodular, and apparently was not adherent to the skin or deeper tissues. The nipple was not retracted and no nodes could be felt in the axilla.

Operation. The right breast was amputated, the skin, mammary tissue, fat and tumor being removed down to the pectoralis major. The tissue was examined immediately by a pathologist, who made frozen sections and reported that the tumor was an adenofibroma, and that there

was no evidence of malignancy. As a result of this report, the wound was closed without dissection of the axilla. Subsequent examination of the tumor, made by another pathologist, Dr. Elser, revealed the presence of carcinoma. This fact was explained to the patient, who consented to a second, radical operation, at which the skin, subcutaneous tissues and pectoral muscles were removed, and a clean dissection of the axilla was made. The patient's operative recovery was uneventful, and there was at the present time no evidence of a recurrence.

The following is the pathological report made by Dr. Elser.

The specimen received is a breast presenting in its substance a large, irregularly ovoidal, remarkably firm tumor, situated in part beneath the nipple. The growth, which was about the size of a goose egg, was sharply circumscribed and shells out readily excepting at one point, where it is firmly attached, and here the tumor seems to extend into the surrounding structures.

The macroscopic diagnosis in this case was a fibroma or a fibro-adenoma, and was based upon transections made from one-half the growth, the remainder being left intact for museum purposes. It may be mentioned that unfortunately the original transections did not include the area mentioned above, where the growth appeared to be invading the surrounding tissue.

Microscopic examination. A frozen section measuring 1 x 2 cm. made from a portion of the periphery of the growth showed the typical appearance of a fibro-adenoma. At one point near the periphery of the section two small islands of epithelium having the appearance of nests of cancer cells were found. Frozen sections were now made from various portions of the growth, all of these presenting the appearance of fibro-adenoma infiltrated in places by more or less numerous cancer cells (Figs 1-5).

Diagnosis. Carcinoma originating within an adenofibroma.

The material received after the second operation consists of pectoral muscles and axillary contents. In the axillary fat, a single hard nodule, the size of a French pea, and several softer, atrophic lymph-nodes were found. Cut sections of the indurated node showed carcinomatous involvement.

This is an instance of a malignant growth in which the characters of the primary benign growth dominated the picture to such an extent that an error in gross diagnosis resulted. The case illustrates the danger of basing the diagnosis on transections of a portion of the tumor only, a common practice where a museum is being maintained. As stated above, the original transections did not pass through the region showing an invasion of the growth into the surrounding structure. It furthermore illustrated that a single section made from a tumor of this size may lead to error in diagnosis, even though a microscopic examination is made. If the first frozen section that was prepared had been only a few mm. shorter, the case would have passed as a benign fibro-adenoma. The advanced age of the patient in this case would naturally suggest a more extensive examination of the tumor.

DR. WILLY MEYER thought that these cases were not so very infrequent. He recalled one similar to that presented by Dr. Pool where all the evidence pointed to an ordinary adenofibroma, but which even-



FIG 1 — Transection of adenofibroma of breast with secondary development of carcinoma. The growth infiltrates adjacent tissues to slight extent at one point



FIG 2 — Frozen section in which masses of cancer cells were first found. 1 masses of cancer cells. B duct surrounded by area of round-cell infiltration. See higher magnification Figs 3 and 4.

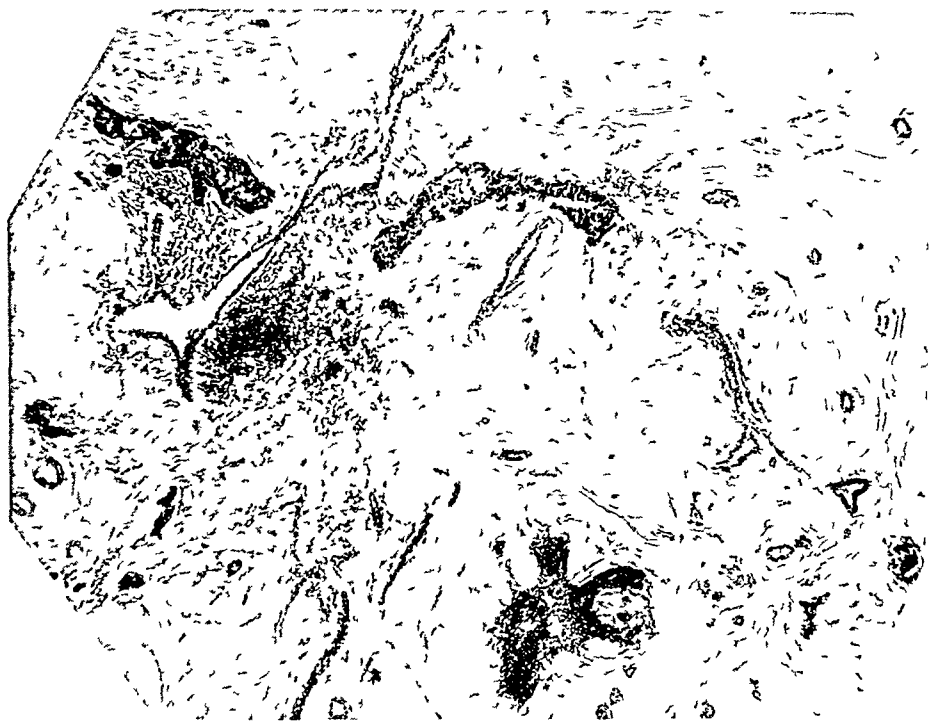


FIG 3 —High power of A and B in Fig 2

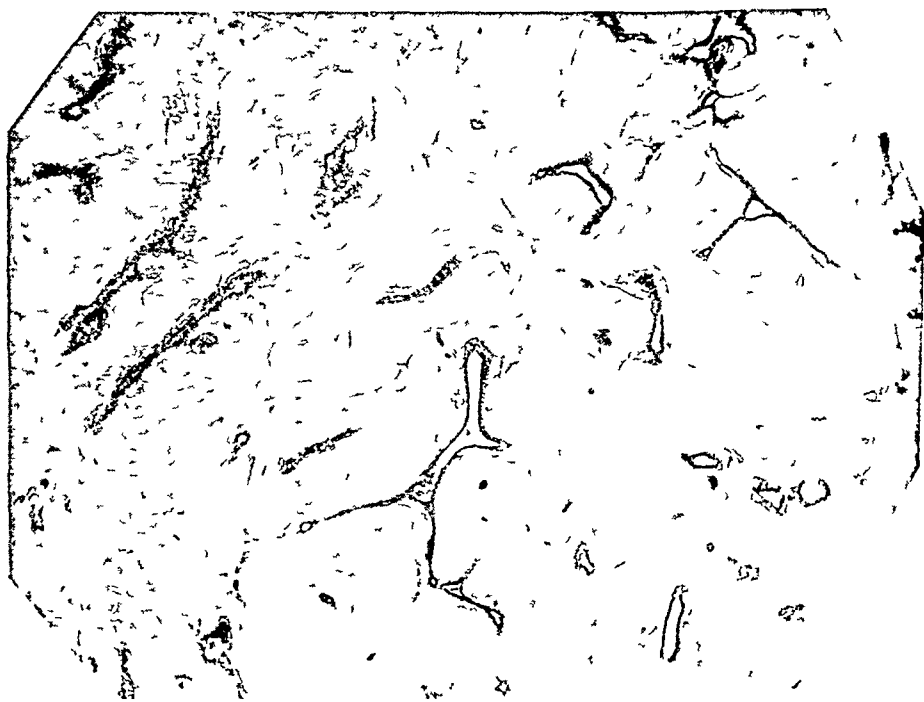


FIG 4 —Area of adenofibromatosis

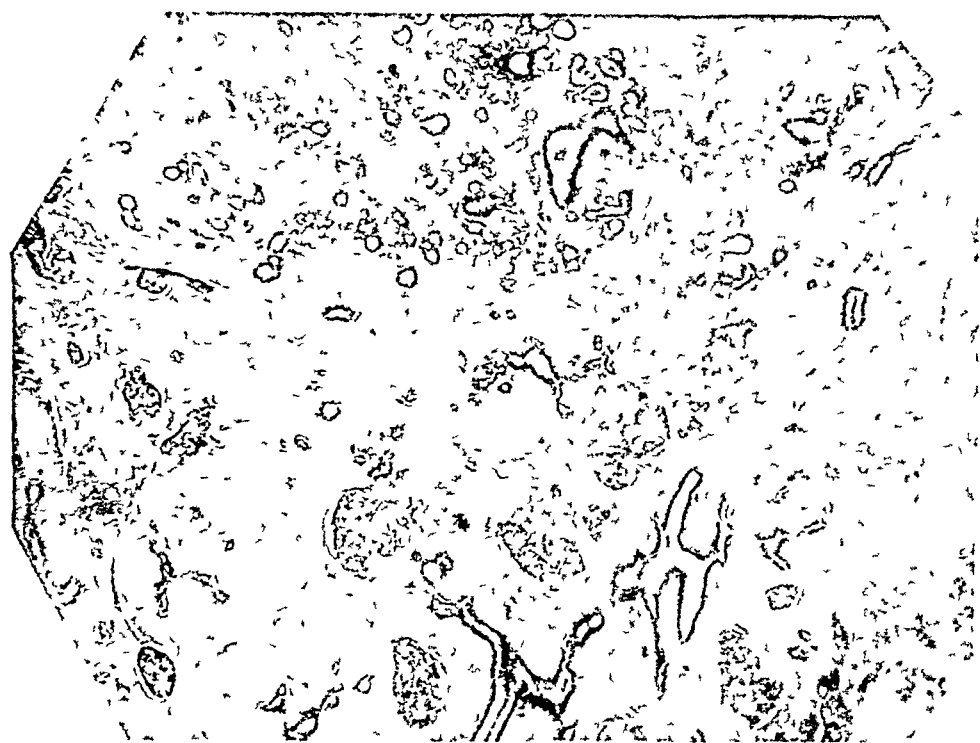


FIG 5 —Showing large nests of cancer cells and islands of adenomatous hyperplasia

PIGMENTED ODONTOMA OF UPPER JAW

tually in one place proved to be one of carcinoma. Such instances only emphasized the importance of careful and *thorough* work on the part of the pathologist in every case of this type. Of course, in his patient the radical operation was promptly carried out at a second sitting.

DR. FREDERIC KAMMERER mentioned a case illustrating the difficulties in the clinical diagnosis of mammary tumors. The patient was an unmarried woman of thirty, upon whom he had operated eleven years ago for a small tumor that presented all the clinical symptoms of a benign adenofibroma. The tumor was encapsulated and easily shelled out. The pathologist reported that parts of the tumor gave the impression of a rather malignant round-cell sarcoma. Half a year later a second similar growth was removed from another part of the same breast, which proved to be a benign adenofibroma. After another six months the entire breast was converted into an even, hard, painless mass. It was removed, the axilla being opened at the operation, and no infiltrated lymph-nodes found. In the further course of the case various recurrences in the scar were observed and removed, and these were submitted to three of our best known pathologists at different times, who all pronounced the growths rapidly growing, very malignant sarcomata. Finally, the case was turned over to Dr. Wm. B. Coley for treatment with mixed toxins who, after three months, did not believe that the patient had been materially benefited. Local recurrences had again appeared in and about the cicatrix and were growing rapidly. One more extended removal was attempted two months after the toxin treatment had been abandoned. The patient had remained well since (eight years) she was married about six years ago and has had one healthy child.

DR. POOL, in closing, thought that Dr. Meyer's experience in regard to the frequency of this condition was unusual. He had discussed the case with three of the ablest pathologists in the city, and although they had seen cases in which the two lesions—adenofibroma and carcinoma—were associated in the same breast, none of them had ever seen a case in which there was evidence, as in this instance, of a carcinoma which had originated in an adenofibroma.

PIGMENTED ODONTOMA OF THE UPPER JAW

DR. A. V. MOSCOWITZ presented an infant, four and a half months old, born in the United States, of Italian parentage. When the child was six weeks old, the mother noticed a swelling of the right jaw; this gradually increased in size, but did not interfere materially with nursing. The child was taken to the Out-Patient Department of the Cornell Medi-

cal College, where two incisions were made into the growth with apparently negative result, and subsequently the family physician extracted a rudimentary tooth that presented itself in one of the incisions

When Dr Moschcowitz saw the baby for the first time, two months ago, there was a swelling of the right upper maxilla which involved the entire palatal surface and encroached upon the body of the jaw, so that the tumor was not only palpable but also readily visible. Roughly estimated, the swelling was about the size of a large English walnut and bled profusely upon the slightest touch from the granulations covering the previously made incisions. A specimen was removed and submitted to Dr F S Mandlebaum for microscopic examination and was pronounced a pigmented odontoma.

The speaker said it was his first intention to extirpate the tumor, however, he gladly accepted the advice of Dr Howard Lilienthal, who saw the case, to first try the effect of intensive X-ray treatment. Dr S Stern kindly consented to give these treatments, and had thus far made seven exposures, and as a result he was of the opinion that the growth had remained stationary. Personally, Dr Moschcowitz said, he was of the opinion that the growth was larger now than it was two months ago.

Odontomata, the speaker said, were exceedingly rare, and still more rarely recognized. An excellent description of this type of tumor was given by Broca, who gave two varieties: first, the hard or crown odontomata, made up mostly of the cement or dentine substance, and, second, the soft odontomata, composed chiefly of pulp substance or peridontium.

The case was shown on account of its rarity and also to obtain an expression of opinion regarding treatment. Personally, in spite of the unfavorable outlook on account of the magnitude of the indicated operation, the speaker said he was inclined to attempt a radical removal.

DR HOWARD LILIENTHAL said that when he first saw this child, about two months ago, through the courtesy of Dr Moschcowitz, he did not believe it was in a condition to survive a radical operation, and for that reason he advised a trial of the intensive X-ray treatment, which had evidently not had much effect. Now there appeared nothing else to do but to either excise it or to try the method of Bloodgood and burn it out with a powerful electrocautery. The former was perhaps preferable in this particular case, as the growth was not of an extremely malignant type. An operation was pretty dangerous, in any event.

DR ARPAD G GERSTER, who had also seen the case about two months ago, thought there had been a considerable increase in the size of the tumor since that time. He then looked upon it as a malignant

STRANGULATED FEMORAL HERNIA

tumor and expressed the opinion that the only thing to do was to take it out, the sooner the better. Personally, he did not believe that the use of the thermocautery was less dangerous than the knife, and it gave no more security against hemorrhage, either at the time of the operation or afterwards. In using the thermocautery, in order to prevent adhesions between the eschar and the instrument, the latter must be kept in constant motion, for if we allowed it to rest for even a moment it became adherent to the baked tissue, and upon its withdrawal a severe hemorrhage was apt to follow. For that reason he considered it less dangerous to do a cutting operation, done as rapidly as possible, the object being to save blood by the rapid removal of the mass, and by packing and compression.

As to the prognosis in a case of this kind, Dr Gerster said that was an entirely different matter. We knew that young children bore hemorrhage very badly, and he could recall cases where the loss of scarcely two drachms of blood after a circumcision gave rise to serious symptoms. In any event, an operation in a case like that shown by Dr Moschowitz was very hazardous, but was the only measure that promised a however uncertain result.

DR WILLIAM A. DOWNES agreed with the previous speakers that an excision of the growth was indicated, and he thought that the preliminary ligation of the external carotid might be a wise procedure. In a discussion on the subject of the preliminary ligation of the external carotid in operations about the head and face at a meeting of this Society some years ago, the consensus of opinion seemed to be that the measure was not of much value, still it might be advisable in such a young child, where bleeding was such an important factor.

STRANGULATED FEMORAL HERNIA SAC CONTAINING APPENDIX ONLY

DR WILLIAM A. DOWNES presented a patient and showed the specimen. The patient was an unmarried woman, twenty-eight years old, a seamstress, who for the past four and one-half years had noticed a lump in the right groin which would make its appearance about once each month, and after remaining for a day or two would disappear spontaneously. Upon such occasions it was very painful, but never gave rise to any other symptoms, such as fever, chills or vomiting.

On November 1, 1914, the lump in the groin appeared as usual, without apparent cause. It was very painful and failed to disappear, as on former occasions. When the patient was admitted to St. Luke's Hospital, on November 6 the tumor and pain were the only symptoms.

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complained of: there had been no fever nor vomiting, and the patient had been able to be up and about. The high operation for femoral hernia was performed—upon opening the peritoneal cavity the cæcum presented and it was found that the appendix passed under Poupart's ligament—only about one-half inch coming into view. No effort was made to draw the appendix through the femoral opening. It was divided at the base and the stump invaginated—neck of sac completely divided and ligated. Intact sac with appendix removed from below. Hardened sac opened ten days later showed distal one-half of appendix completely gangrenous.

DR. GERSTER said that many years ago, in the early eighties, he saw a woman, about forty-two years old, who for some time had had an inguinal hernia for which she wore a truss. One day the truss broke, and as she felt no inconvenience, she got along for a time without it. The hernia gradually increased in size and finally became painful, with symptoms of incarceration and strangulation, with persistent vomiting and fever. When Dr. Gerster saw her he diagnosed a strangulated hernia and sent her to the German Hospital. Upon opening the hernial sac, about six ounces of pus escaped, and within the sac was seen a portion of the cæcum and the appendix, which was perforated, with a fish-bone protruding through the perforation. The perforated appendix had apparently given rise to local intrasaccular peritonitis, with oedema and strangulation of the section of gut within the hernial sac. This case, the speaker said, occurred long before the question of appendicitis became well understood through the labors of Fitz, Sands and McBurney, and as there were no established rules as to how to deal with the appendix, he simply ligated it, liberated the strangulated gut and closed the wound, with drainage. This soon relieved her acute symptoms and eventually the patient made a perfect recovery. Of course, she retained her hernia.

Dr. Gerster said he subsequently learned that this patient had been eating codfish, and he still had in his possession a portion of one of the ribs of the fish that had caused the perforation.

DR. FRANZ TOREK said he had found the appendix in the sac of a left inguinal hernia.

DR. LILIENTHAL said that he had seen a case of congenital hernia, strangulated, in a three-weeks-old child that was born six weeks before its time. On operation, the hernial sac contained the appendix, which was strangulated and gangrenous at its distal part. It was tied off and put back, and the wound packed with gauze. The patient made a good

CARCINOMA OF THE ŒSOPHAGUS

recovery An interesting finding in the case was that although this child was breast fed and only three weeks old, the colon bacillus was found in the appendix at that early date

THE OPERATIVE TREATMENT OF CARCINOMA OF THE ŒSOPHAGUS

DR FRANZ TOREK read a paper with the above title, for which see April issue of ANNALS OF SURGERY

DR WILLY MEYER said that Dr Torek's successful case of resection of the thoracic portion of the œsophagus was a source of pride and satisfaction to American surgeons With the patient in such excellent condition in which she was shown here to-night, the case might well be looked upon as promising to become a permanent cure, all the more as the tumor proved to be a squamous-celled epithelioma, the most benign of all types of cancer in the gastro-intestinal tract, if we might stretch the latter to include the œsophagus

The progress that had been made in resection of the œsophagus for carcinoma within the past two years was remarkable The definite recognition of the fact that it was best for the patient to have the proximal stump of the œsophagus transposed, from the posterior mediastinum antethoracically under the skin downward, had proven the most important factor in this progress This transposition was almost simultaneously done by Ach and Rehn, Jr, abroad, and Torek in this country The tumor was approached in one of two ways, *i e*, either transpleurally or retropleurally In this country the former route was favored, while Ach and Rehn preferred to work in the posterior mediastinum without opening the pleural sacs It was to be hoped that the latter authors would take up this work again after the war had come to a close, so that we might have a chance of drawing comparisons The question was an important one and should be settled

The second important point we had learned was the proper selection of the cases for radical work This could often only be determined in the course of the operation Extensive infiltrating carcinomas which had caused symptoms of stricture for many months and covered a large portion of the tube should not be attacked radically if situated entirely, or in part, behind the aortic arch The nerve centres could often not withstand the unavoidably severe interference with both pneumogastric nerves and their branches to the sympathetic system running to heart and lungs However, here a palliative operation might still be done if the patient's condition permitted Just as we were doing gastro-enterostomy in cases of inoperable stricture of the pylorus, so the

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oesophagus might be divided above the upper end of the tumor, the distal end safely inverted and the proximal end brought in front of the thorax. The patient would then again be able to swallow, and thus his most ardent wish would be fulfilled. He should be left under the impression that the planned radical work was done, the relatives being made acquainted with the true facts.

The Beck-Jianu method of combining inferior oesophagoplasty with gastrostomy was an excellent procedure, and the speaker said he had done this in six cases, with six recoveries. In the last case the tip of the new oesophagus reached up to the clavicle. In the case shown by Dr. Torek, the lower end of the proximal stump reached down to the second rib. If, in a similarly favorable case, the Beck-Jianu operation were done primarily, total oesophagoplasty could be incidentally accomplished.

The third point which bids fair to be of great help in improving the results of the operation was the addition of drainage. To emphasize this, Dr. Meyer cited the case of a man sixty-five years old, who was operated on by him in March, 1914, for a cancerous stricture of the oesophagus. A resection was done and the man stood the operation well but succumbed to an infectious pleurisy seven days later in spite of *subsequent* drainage. In this case the thorax was sealed hermetically at the time of the original operation, and if drainage had been employed at that time, his chances of recovery would have been greatly enhanced. The speaker thought that drainage should be added in every case where the lumen of the oesophagus was exposed in the course of the operation. That a patient after oesophageal resection recovered when the thorax was completely closed would be exceptional, and the evacuation of an infected pleural effusion subsequently might often prove too late in debilitated patients. In his service at the German Hospital, these patients were left under differential pressure for from twelve to fifteen hours in order to avoid a post-operative acute pneumothorax. Where this could not be done, a Tiegel drain might well be used. No doubt other methods would be devised for this purpose in the future.

Of course, early diagnosis followed by early operation was the desideratum for greater success in resections of the oesophagus for carcinoma, and it was to be hoped that radiography would prove of particular assistance in accomplishing this end. Drs. Wilborn H. Stewart of this city and Hessel of Germany were working successfully along these lines. They had the patient swallow a casing sealed at its distal end, which, after having passed the stricture, was filled with bismuth paste, and irregularities of the oesophageal wall could then be

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made out at an early stage. But of more importance still, for further progress in this field of surgery, was the aid of the general practitioner, to whom, naturally, these patients first applied for aid. If a patient who complained of difficulty in swallowing were promptly sent to a hospital in order to have the diagnosis established without delay, the chances of a successful operation would be immeasurably greater.

DR N W GREEN said that when he and Dr H H Janeway were working on this subject it was their experience that this operation, especially the resection of the whole œsophagus, had been a very fatal one as carried out in the laboratory upon dogs. He thought that Dr Torek gave the key-note of his success when he spoke of the importance of earlier diagnosis and operation on these patients. In one case that had come under his observation the tumor was situated at the bifurcation of the bronchi. It proved to be an epithelioma of the œsophagus and finally perforated into the bronchi, the patient dying of a septic pneumonia. No metastases were observed. Metastases from these growths appear to form rather late.

DR MOSCHCOWITZ thought that carcinoma of the œsophagus was decidedly on the increase. Scarcely a week passed that such a case did not fall under his observation, and always, unfortunately, in an inoperable stage, so that only a gastrostomy was allowable. There was one case under his observation, however, where he hoped to do a resection of the œsophagus in its cervical portion.

DR KAMMERER said he had made one attempt to remove a cancer of the œsophagus lying behind the arch of the aorta through the thoracotomy incision advocated by Dr Torek. After ligation of some of the intercostal vessels the aorta was sufficiently mobilized to expose the growth and to permit its removal, but it was soon seen that both vagi were involved, and the attempt was, therefore, abandoned. The patient collapsed and died rather suddenly on the third day. The speaker believed—to judge from what he had witnessed at the hands of other surgeons—that these so-called exploratory thoracotomies for cancer of the œsophagus were followed by a very high mortality, especially where an attempt had been made to remove the tumor. Sauerbruch recommended a small intercostal incision, through which the hand of the operator could be introduced and the operability of the tumor determined, and Dr Meyer had spoken this evening of the possibility of improvement in the X-ray examination of tumors of the œsophagus, but from what the speaker had seen he was compelled to conclude that most surgeons—at least up to the present moment—needed a thorough exposure of the growth to determine whether it could be removed or

not It was to be hoped that this high mortality could be reduced, but the outlook at the present time was not very encouraging

DR TOREK, in closing, took up the question of drainage, and said that the operation should be planned in such a manner that drainage would be unnecessary By checking all hemorrhage and mastering all possible sources of infection the necessity for drainage was set aside In fact, the presence of a drain would expose the patient to subsequent infection If, on the other hand, through some accident, the surgeon was unable to leave the wound clean and dry, drainage was indicated, but it should be avoided, if possible

As to the X-ray as a diagnostic aid, the speaker said he did not think it could tell us whether the tumor was inoperable or not It gave no exact information in regard to metastases, nor did it tell us whether the growth was still confined to the œsophagus or had already involved the connective tissue or even the lung, except in far advanced cases Only an exploratory operation would disclose these points As to the value of a small incision for exploratory purposes, that, too, he regarded as unsatisfactory The hand could not be introduced through a small incision in the thorax, and we could not learn in this way whether the tumor was operable or not

DIVERTICULUM OF THE ŒSOPHAGUS COMPLICATED BY ABSCESS OF THE LUNG

DR FRANZ TOREK reported this case and showed the specimen The patient, after having had a slight cough for some time, was taken sick rather suddenly with pain in the right side of the chest There was slight dulness over a limited area He developed a high fever, 104° and over, which, with occasional remissions, lasted many weeks During this time he perspired freely and expectorated large amounts of fetid material, a mouthful at a time, the odor of which was sometimes absolutely unbearable Elastic fibres were found in the expectorated material He also gave a long-standing history of regurgitation of swallowed food which would occasionally become lodged over the larynx and give rise to cough, especially at night With careful gargling, aided by pressure on the neck, he often succeeded in clearing out the food remnants

With these symptoms and this history, the patient came under Dr Torek's observation in the spring of 1914 The symptoms pointed to a diverticulum of the œsophagus and an abscess of the lung, probably with secondary gangrene Bougies introduced into the œsophagus were halted at a point corresponding about to the upper thoracic aperture

DIVERTICULUM OF THE ŒSOPHAGUS

An X-ray picture of the lungs showed a shadow on the right side, about the middle of its lateral half. This shadow measured three inches from above down and three and a half inches across. The roentgenogram of the œsophagus showed the presence of a diverticulum, about an inch and a half in diameter, just below the cricoid cartilage. It was certain, therefore, that he had to deal with a diverticulum of the œsophagus complicated by abscess of the lung, the latter being doubtless caused by aspiration of foreign material which had been dislodged from the diverticulum. It was most likely that this occurred at night.

Naturally, these two conditions made a very unhappy combination, inasmuch as the presence of the fetid expectoration endangered the prospects of aseptic healing of the œsophagus after an operation on the diverticulum, and, on the other hand, the presence of the diverticulum led to a persistence of the danger of aspiration of foreign material into the lung, besides interfering with proper nutrition. Furthermore, the administration of ether or chloroform had to be considered seriously as introducing an element of danger in the presence of the pulmonary affection.

To meet these difficulties, it was planned, in the first place, to operate under local anæsthesia, and, second, to await a period of remission from the high fever for performing the operation. When the patient was kept perfectly quiet, the elevation of temperature remained moderate, but as soon as he was a little more active, a high fever would set in.

On May 5, 1914, Dr. Torek undertook the operation under anæsthesia with novocaine and suprarenin, one-half per cent. The deep injections, 15 c.c. or more, were made from the posterior border of the sternocleidomastoid muscle, whereas the region of the trachea, the sternothyroid, sternohyoid and platysma muscles and the subcutaneous connective tissue were injected from points at the anterior border of the sternocleidomastoid muscle. An incision was then made along the anterior border of the left sternocleidomastoid muscle from the hyoid bone to the clavicle through skin, platysma and superficial fascia. The sternocleidomastoid muscle was retracted laterally, and the sternohyoid mesially, while the omohyoid was divided. The middle layer of the deep cervical fascia, which also envelops the thyroid gland, was divided mesially to the carotid sheath. Now the thyroid gland, the larynx and the trachea were retracted, together with the sternothyroid and sternohyoid muscles, to one side, and the great vessels to the other, together with the sternocleidomastoid muscle, and the inferior thyroid artery was divided where it crossed the œsophagus. The

diverticulum, which took its origin from the posterior wall of the œsophagus, was then exposed, grasped with a blunt forceps, and thoroughly freed up to its neck by blunt dissection. The introduction of a bougie to aid in its identification was not necessary. The neck of the sac being large, it was not tied before ablation, as was done in the case of small-sized necks, but it was cut off and sutured in two layers: fine silk being employed.

The anæsthesia was very satisfactory. The patient, who was himself a surgeon, described his sensations very accurately. He felt pain only on two occasions: the first was at one of the deepest injections when the point of the needle must have struck a nerve, the second was at a time when the diverticulum was tugged at rather forcibly. The anæmia produced by the suprarenin was a rather welcome concomitant of the method of operating under local anæsthesia.

Recovery was entirely uneventful. For two days, food was given per rectum only. On the third day water was given by mouth, then fluid food up to the twelfth day, after that soft food was allowed. An œsophageal tube was not employed for introducing the food. Inasmuch as the patient was very careful and fully appreciated the importance of taking only small quantities at a time in order to avoid stretching the œsophagus and thus endangering the integrity of the suture, he was permitted to swallow early. In fact, in this case, considering the existence of a focus of infection in the lung abscess, the oft-repeated washing of the œsophagus by a small swallow of some sterile fluid was believed to be rather advantageous.

The most interesting feature in this case was the subsequent behavior of the lung abscess. As soon as the aspiration of foreign material from the diverticulum had been checked by the removal of that sac the lung abscess began to take care of itself. The cough gradually subsided and the expectoration became insignificant. In a roentgenogram taken as early as two weeks after the operation, the shadow area in the lung was seen to have diminished in size and to have become much fainter. No further X-ray pictures were taken, but the patient had entirely recovered and was now actively attending to his practice.

DR KAMMERER said he had operated on a case of diverticulum somewhat similar to Dr Torek's case a year and a half ago. X-ray examination alone had revealed the true nature of the trouble after prolonged and repeated attempts to introduce various sounds into the stomach had absolutely failed. Even Plummer's sounds passed over a silk thread, would not enter beyond the diverticulum, though traction upon the thread raised the sound out of the pocket behind the diverticulum.

DIVERTICULUM OF THE ŒSOPHAGUS

gus The neck of the sac was rather small and was easily ligated at operation, this ligature being reenforced by a row of sutures There was no leakage A soft rubber tube could be easily passed into the stomach after the diverticulum had been removed

DR MOSCHCOWITZ said his experience with drainage in operating upon the Œsophagus had been very unsatisfactory, as the use of a tampon was invariably followed by leakage More recently, he had discarded all drainage excepting the insertion of a small rubber dam, and his results had been better

DR EDWIN BEER said he had seen three cases of diverticulum of the Œsophagus, and in every instance the X-ray picture was absolutely characteristic, in fact, the diagnosis was based upon it in every one of these cases In the first case no instrument could be introduced into the Œsophagus except under general anæsthesia, and the closure was attributed to a spastic spinal cord condition analogous to a similar urethral condition observed in the same patient The X-ray cleared up the diagnosis The second case was diagnosed as one of carcinoma of the Œsophagus and a gastrostomy was done The patient came to him fourteen months later, and the X-ray showed a typical diverticulum In the third case, which was seen quite recently, the diagnosis was also established by the X-ray

TRANSACTIONS OF THE PHILADELPHIA ACADEMY OF SURGERY

Stated Meeting, November 2, 1914

The President, DR JOHN H GIBBON, in the Chair

SARCOMA OF THE TONSIL TREATED WITH RADIUM

DR NATHANIEL GINSBURG presented a man, forty-nine years of age, who was brought before the Academy of Surgery a month ago with a tumor of the right side of the pharynx. The condition had been diagnosed as an inoperable malignant tumor of the right tonsil. The case was apparently hopeless from the stand-point of further surgery and the patient was sent to Dr Newcomet for the use of radium. The entire right side of the throat was filled by a mass which has now entirely disappeared.

DR JOHN B ROBERTS said that he wished Dr Ginsburg could tell what the clinical characteristics of really malignant tumors of the tonsil are. There is difficulty in recognizing them with certainty. Three or four years ago a man in his ward at the Methodist Hospital said to him, "You don't recognize me, do you, Doctor? I am the man from whom you took the cancer of the tonsil." He then recollected that about ten years before he had operated upon him for malignant disease of the left tonsil. He supposed he was dead long ago. He had sawed his jaw apart, after chloroforming him by means of a tube passed through a tracheal incision, and took out the tonsillar growth and also a portion of the soft palate. No radium was applied and no X-ray. It was before we were familiar with radium and probably before the X-ray was used to any extent. Yet here was a man who lived something like ten years with no return of what was pronounced, by the pathologist making the microscopical examination, a malignant tumor. The neck was sent to Dr Walter Roberts, who could find nothing wrong, except a cicatricial condition where about ten years before there had been this mass. There is something peculiar about these tonsillar growths which is not understood and which the pathologists do not recognize as to the histological structure. Some years previously Dr Roberts saw a tonsillar growth, which had been diagnosticated by a renowned laryngologist as a malignant tumor. The family physician and the speaker believed it to be syphilitic. This, active treatment proved to be the true diagnosis.

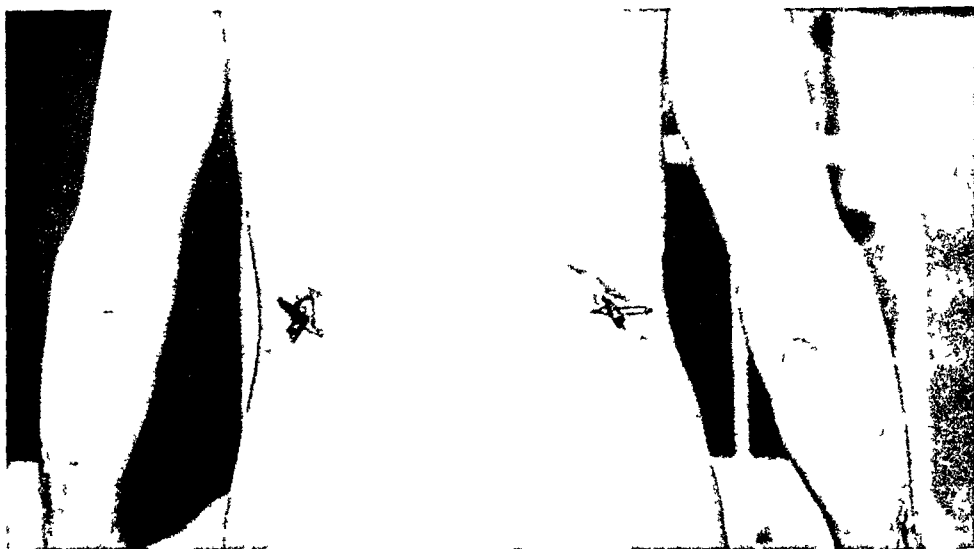


FIG 1 —Bilateral nephrostomy drains emerging in each lumbar region

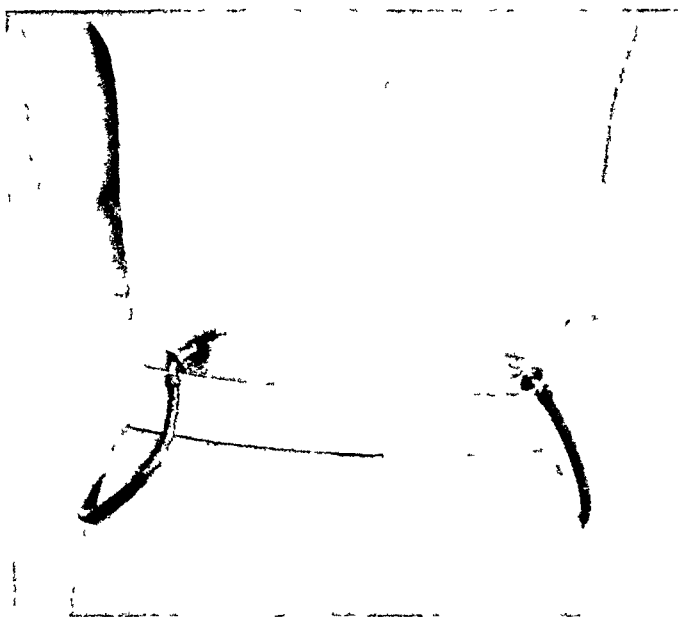


FIG 2 —Tubes attached to carry urine to receptacle in front

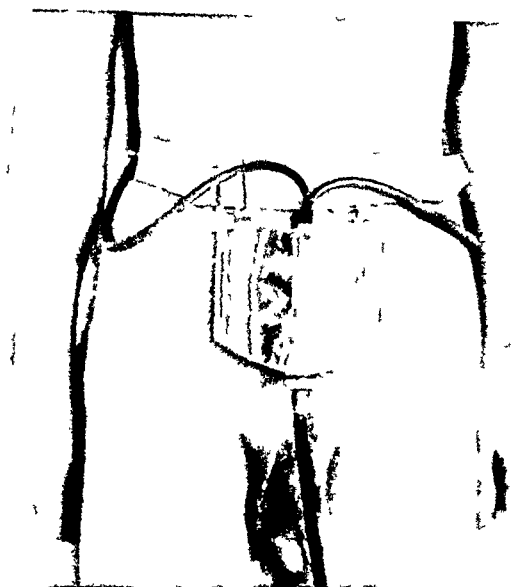


FIG. 3—Nephrostomy. Urinary receptacle in front above pubis receives urine; drains emerging behind

DRAINAGE AFTER NEPHROSTOMY

DR B A THOMAS presented a patient who had had two nephrostomies. One side was operated upon in last January, the other in February. The Watson apparatus did not work satisfactorily in this case. After taking the course of the fistula, he then devised two sterling silver drains to which tubes were attached to convey the urine around in front to a receptacle. The photographs (Figs 1, 2 and 3) show the patient before and after the use of the Watson apparatus and also with the silver drains inserted. Inside the silver drains have bulbous extensions which prevent their displacement, also external flanges which prevent them from going in too far. It has been almost a year since the operations were done. The man has multiple recurrent polypi of the bladder and has been coming to the dispensary every other day for several months for dressings. In taking the drains out last week for washing and removal of contained phosphatic deposits considerable pain was caused. The man has gained ten pounds in weight since the operation, is in much better condition than before his nephrostomies, and insists upon his third promised operation—a cystectomy, which will be performed in a few days.

THE SURGICAL ANATOMY OF THE UPPER AND LOWER POLES OF THE THYROID GLAND WITH REFERENCE TO THYROIDECTOMY

DR NATHANIEL GINSBURG read a paper with the above title, for which see page 268.

DR A P C ASHHURST said that several years ago as a result of elaborate experiments Delore and Alamartine pointed out that the circulation of the thyroid is much freer between the upper and lower poles of each lobe than across the midline. On this account they advised ligation of the superior and inferior arteries on the same side instead of both superiors, as had been done usually before. They also urged ligation of the inferior artery near its origin, exposing it by incision on the outer side of the sternocleidomastoid muscle. Dr Halsted recently also has come to the conclusion that the inferior artery is best ligated, not close to the gland, but somewhere nearer its origin.

THE PREVENTION OF POST-OPERATIVE INTRAPERITONEAL ADHESIONS

DR R H CHANEY read a paper with the above title, for which see page 297.

DR GEORGE G ROSS said that it seemed to him very evident that the formation of adhesions is a beneficent act of Nature to prevent the spread of infection, and that prevention of adhesions is not always

an advantage to the individual. The excess of adhesions is a different problem, and a most serious one in surgery. When adhesions become a menace to the patient by causing obstruction, changing the position of, or interfering with, the mobility of organs and by recurring after being broken up, they form a problem which is still unsolved, and one of vast importance. The paper, however, does not seem to throw any light upon the immediate solution of this problem. I should like to ask how we may prevent this type of adhesions.

DR A BRUCE GILL called attention to another class of cases in which intestinal adhesions occur that may lead to the death of the patient. When a general peritonitis follows the rupture of a gastric or duodenal ulcer, adhesions are formed between the loops of gut and between the gut and the parietal peritoneum. Thus localized collections of pus are formed that are not drained by gravity. Such collections may be found beneath the spleen while the patient has been kept in the sitting posture and suprapubic drainage maintained. Death occurs from absorption from these peritoneal abscesses that are undrained. The problem seems to be to prevent the formation of such collections of pus by preventing peritoneal adhesions during the acute stage of general peritonitis. With this object in view, in his last case of ruptured duodenal ulcer with evidence of general peritonitis he flushed out the peritoneal cavity with a solution of sodium citrate, 1 per cent, and sodium chloride, 2 per cent, at the time of operation, and proposed to repeat this procedure at intervals by pouring the solution into the upper abdominal wound and allowing it to escape from the suprapubic wound. However, the patient was in such degree of shock on his admission to the hospital that he died an hour after the operation was completed.

It seemed to him that the objections to the use of citrate solution mentioned by Dr Sweet do not hold in cases of general peritonitis where free drainage is essential to the recovery of the patient and where adhesions prevent such drainage in spite of the force of gravity.

If the closure of the perforation in the gut should be delayed by the presence of the citrate, this would not be an insuperable difficulty.

DR A P C ASHURST inquired whether Dr Sweet employed a 3 per cent solution of citrate in normal salt solution, or if he used the 2 per cent solution of sodium citrate in a 3 per cent (hypertonic) salt solution, as advised by Saxton Pope himself.

DR CHANEY, in closing, said that they used the 3 per cent citrate in normal saline because that was the solution used by Koch in his work upon rabbits and with which he found very satisfactory results.

ARTERIOVENOUS ANEURISM OF FEMORAL ARTERY

ARTERIOVENOUS ANEURISM OF THE FEMORAL ARTERY AND VEIN

DRS EDWARD B HODGE and J E SWEET reported the following case because of the relative infrequency of the condition present and the favorable result so far obtained by modern surgical methods

C M, aged twenty-nine years, was referred to the service of Dr Hodge at the Presbyterian Hospital, May 19, 1914, by Dr E H Goodman with the diagnosis of arteriovenous aneurism of the left femoral artery In May, 1898, while cleaning a revolver, he accidentally shot himself, a 32-calibre bullet entering the inner side of the left thigh about its middle, and being later removed from beneath the skin on the outer aspect

There was free bleeding, spurting to a height of 12 inches He walked downstairs, fainted, and soon the hemorrhage ceased With no ligatures and simply an occlusive dressing, the wound healed after two weeks in bed A year later, he noticed a pea-sized lump at the point of entrance and also began to have a sensation in the leg described as "buzzing" Two years ago—14 years after the accident—the leg began to swell and in the last year this has increased markedly With the enlargement has gone an increase in the "buzzing" sensation The latter is noticed only at night and, with the marked pulsation and throbbing now present, keeps him awake There is no actual pain or tenderness present

The general physical examination by Dr Goodman reveals nothing abnormal except a slight apical systolic murmur transmitted to the angle of the scapula

The left thigh is somewhat full From about 5 cm above Poupart's ligament to the small scar at mid-thigh is an irregular, soft swelling following the line of the vessels Over this swelling is noted a strong, expansile pulsation, a marked thrill and a loud to-and-fro murmur

The latter is conducted well into the leg, being heard distinctly half way to the ankle Pulsation is present in both tibials The right thigh measures 42 cm, the left 46 cm The Wassermann was negative

It seemed a good opportunity to have the benefit of the skill in vascular surgery possessed by Dr J E Sweet, Professor of Experimental Surgery in the University of Pennsylvania Dr Sweet kindly saw the patient and, with Dr Hodge's assistance, operated as described below It is to be noted that at operation both artery and vein were found enlarged, the vein much more so To the dilatation of the latter is to be ascribed the swelling of the thigh in the last two years finally involving the external iliac

Convalescence was marked only by a rather higher temperature range than might be expected. There was aseptic healing. From the time of operation, the patient had no trouble with the leg, sleeping well. Pulsation, thrill and murmur were absent. On June 5, the left thigh measured only 0.5 cm. more than the right. When last observed, August 27, the patient felt perfectly comfortable and local conditions were as noted in June.

DR. SWEET added that the choice of the method to be followed in an operation for arteriovenous aneurism will depend upon the peculiarities of the given case, and may indeed depend upon the condition there found after more or less extensive dissection on the operating table. In the present case a pulsating tumor existed, extending from a little below the scar of the traumatism at the middle of the thigh to well above Poupart's ligament. An extirpation could not be considered and the quadruple ligation of classic recommendation would have to be undertaken upon diseased vessel walls.

The only tenable suggestions were the separation of the vessels with sutures of the resultant longitudinal wounds, or simply closure of the connecting channel with no attempt at separation. There seemed to be no reason for the extended dilation of the vessels except the mechanical disturbance of the blood current, the patient was young, did not show any evidence of general arteriosclerosis, gave a negative history as to syphilis and alcohol. It was therefore argued that since no other explanation could be found for the enlargement of the vessels than the disturbed course of the blood stream, the correction of this disturbance would result in the healing, or at least marked reduction in size, of the enlarged vessels. After the vessels had been dissected out and the communicating channel found, a small clamp was applied to this channel (Fig. 4), the thrill immediately ceased and pulsation in the vein was no longer felt. The vessels were adherent for about $1\frac{1}{2}$ inches. The actual communication appeared to be about $\frac{3}{4}$ inch in length.

The channel was permanently closed by a row of fine silk interrupted sutures, passed through and through at the side of the clamp, and the clamp was removed. This was done without attempting to control the blood current except by placing an Esmarch bandage in position to meet any possible accident. The last suture cut through at the upper angle and a slight hemorrhage occurred, which was controlled by proximal digital pressure and stopped by placing another suture. This incident emphasizes a point not made sufficiently clear, if even mentioned in the articles on aneurism, namely, the difficulty of suturing the walls of a diseased artery or vein. It is not difficult to obtain beautiful exposure

mental results on normal vessels, but it is positively dangerous to transfer these results to diseased blood-vessels. This tissue will not hold the fine sutures nor can it be depended upon to hold sutures for any length of time, even when the sutures may seem to be successful at first, secondary hemorrhages have often occurred.

These remarks do not necessarily apply to the Matas method of dealing with a true aneurism, where layer after layer of sutures can be applied to the diseased vessel wall. Excision of the vessels and direct anastomosis of their ends might well be possible, and was indeed done by Murphy in 1897. The cases where this idea is practicable are rare, and the method can only succeed where the vessel walls are relatively normal, as they were in Murphy's case—a recent gun-shot injury. Lateral suture of the vessels is likewise not promising because of the friability of the vessel walls, except perhaps in a case in which a large sac existed between the vessels which could be pleated over the lateral sutures of the vessel walls.

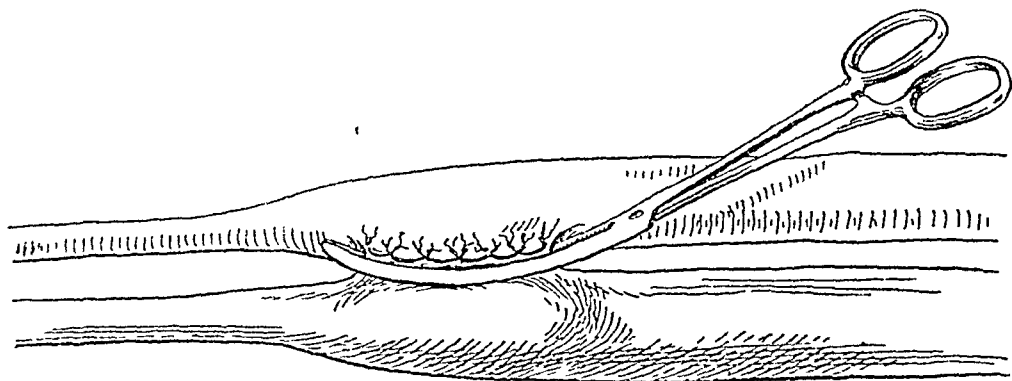


FIG. 4.—Clamp and suture of anastomotic ridge between artery and vein

In this case the vessel sheaths and all the available surrounding tissue was brought over the vessels in several layers to bring pressure upon the vessels as far as exposed. Stewart, of New York, had succeeded in one case with a similar technic.

The order of choice of method to be decided for each individual case, perhaps not until the operation can disclose the exact relations of the vessels, is (1) the simple ligation of the connecting channel, if this be small enough to permit a closure by ligation, if not, its closure by one or more rows of sutures passed through both walls of the intercommunicating channel, (2) in the presence of a definite sac between the vessels, or as a part of one vessel, to restore the contour of the vessels by rows of sutures placed from the outside and plicating the sac over these sutures for support, (3) if the vessels show little evidence of disease, resection and end-to-end anastomosis, although this

type of case would probably be the most suitable for the method first described, and (4) as a measure of last resort, quadruple ligation

DR GWILYM G DAVIS said that he saw a case some years ago in a child in which, while a physician was doing a circumcision, a movement of the child threw the knife on the thigh, puncturing the vessels. Subsequently an arteriovenous aneurism occurred and he was brought to him at the age of nine or ten on account of marked difference in length of the two extremities. The leg in which the arteriovenous aneurism had occurred was much longer than the other. In other words, apparently the arteriovenous communication had increased the growth very much. Of course, when a person is in the period of growth, a difference in the nutrition of the two limbs would tend to make a difference in their length. Beyond the period of growth, however, it is not to be expected that there should not be any difference in length. It is interesting to know that the transference of arterial blood into venous channels has a marked effect on the growth of a limb. If this could be done at will it would be a desirable means of increasing the length of the shortened limb in certain cases, such as occur after hip disease and various other disabilities.

DR JOHN B ROBERTS said that it had seemed to him for many years that "arteriovenous fistule" was a better term for this condition than arteriovenous aneurism. His experience was limited to one case years ago, in which he had the whole leg slough after an operation done by the then ordinary method of arterial ligation. Amputation was necessary, and death occurred.

DR HODGE, in closing, said that the condition could very accurately be described by the term suggested by Dr Roberts. The communication between the two vessels looked like a gastro-enterostomy opening. The opening was too large to ligate and the suggestion made by Dr Sweet seemed to be the better method.

DR SWEET added that the two vessels which were uniformly enlarged were joined together toward the lower end of the enlargement by a channel about one and a half inches long. The vessels were dissected out until he could pass his finger behind the channel and then the little clamp was placed as shown in the diagram, the pulse immediately returned in the arteries below the site of operation, even in the arteries of the foot. Then he made this closure permanent by inserting a row of interrupted sutures. From Dr Davis's description of his case he inclined to the idea that one leg grew more than the other because of better blood supply, although he was not able to understand under these conditions how there would be a better blood supply.

EGGSHELL FRACTURE OF HEAD OF METATARSAL

SOME EXPERIMENTS ON THE SURGERY OF THE PANCREAS

DR J E SWEET read a paper with the above title, for which see page 308

EGGSHELL FRACTURE OF HEAD OF METATARSAL

DR PENN G SKILLERN, JR, reported the case of a woman, aged forty years, who stubbed the second toe of her right foot against the floor. Clinical examination revealed swelling and "wincing" tenderness at the head of the second metatarsal bone. Skiagram (Fig 5) revealed a loss of the normal convexity of the articular surface of the head of the second metatarsal bone, there being instead an irregularly flat surface with broadening of the head. The lateral view (Fig 6) clearly reveals an oblique indentation, which resembles that of the proverbial egg of Columbus. There were no loose fragments. Treatment consisted in the application of a pad to the sole of the foot behind the head of the second metatarsal bone so as to keep the involved area clear of the ground, and thus free from the pressure of the body.

Dr Skillern said that this is the seventh case of this injury on record. Freiberg (*Surg, Gynec, and Obstet*, 1914, XIX, 191) first called attention to the injury and reported six cases, all occurring in women. These patients had stubbed their toes in some manner, in two while playing tennis. They complained of pain in the ball of the foot in weight-bearing only. Freiberg suggests the following mechanism: "Under normal circumstances the second metatarsal bone is slightly longer than the first. In the presence of a diminished power of toe flexion, especially of the great toe, it is apparent that forcible impact against the ground of the ball of the foot, which is not sufficiently guarded by the flexor power of the toes, will cause the exposed distal end of the second metatarsal to bear the brunt of the blow."

The diagnosis must be made from metatarsal pain due to static weakness, and this is probably the reason why more cases have not been discovered. The rule is that in static weakness both feet are involved. Metatarsalgia or Morton's toe usually concerns the fourth metatarsal, and is paroxysmal in nature. There may be a history of having stubbed the toes. By reason of its close proximity it seems to the writer that fracture of the external sesamoid of the hallux must also be ruled out, but the mechanism of this injury is quite different.

The treatment consists in the use of a pad applied to the plantar surface of the foot by means of adhesive plaster, so that its anterior end is placed just back of the injured point. If there are loose bodies their removal by arthrotomy is necessary, unless few in number and very small.

It seemed to the reporter that the term "infracion" is undesirable. We are in reality dealing with an impacted fracture. In the mechanism and in the effect upon the oval head of the bone one is forcibly reminded of the proverbial manner in which Columbus solved the problem of making an egg stand on end, and for this reason, as well as the similarity of the compact layer of bone of which the periphery of the head is composed, he suggests the term "egg-shell fracture" as being more appropriate and descriptive.

FRACTURE OF PROCESSUS POSTICUS TALI WITH FRACTURE OF CALCANEUM

DR SKILLERN reported the case of a man, aged thirty-eight years, who fell in a tank, injuring his right foot, for which he was admitted to the University Hospital, service of Dr Charles H Frazier. Clinically, bony landmarks were obscured by great swelling, but there was "winching" tenderness along the fore part of the calcaneum, a fracture of which was suspected. Skiagram (Fig 7) revealed a comminuted fracture of the antero-inferior portion of the calcaneum. It also showed a fracture of the processus posticus of the astragalus, probably from the impact of the dorsum of the calcaneum. The usual treatment of fractures about the foot was instituted.

According to Stimson (*Fractures and Dislocations*, 7th ed., 1912, 459) fracture of processus posticus tali was first mentioned by Gloquet, in 1844. Lilienfeld (*Archiv f klin Chir*, 1905-1906, LVIII, p 915) says the combination of fracture of the calcaneum with fracture of the processus posticus tali, as in this case, is by no means rare, and that isolated fracture of the processus posticus tali occurs more frequently than is diagnosed. Of 600 fractures observed by him at the Zander-Institut, there were 7 isolated fractures of the processus posticus tali and 5 in conjunction with fracture of the calcaneum.

The cause of fracture of the processus posticus tali is a fall upon the heel with the foot in plantar flexion, thus impacting the calcaneum against the process. The clinical diagnosis is made by the history of the injury and localized tenderness elicited by deep pressure with the finger above the external attachment of the tendo achillis. There may also be a slight concavity of this tendon just above its insertion.

Stimson and others confuse fracture of the processus posticus tali with the inconstant os trigonum. Thus, Stimson quotes Lilienfeld as having observed 12 fractures of the os trigonum, whereas a refer-

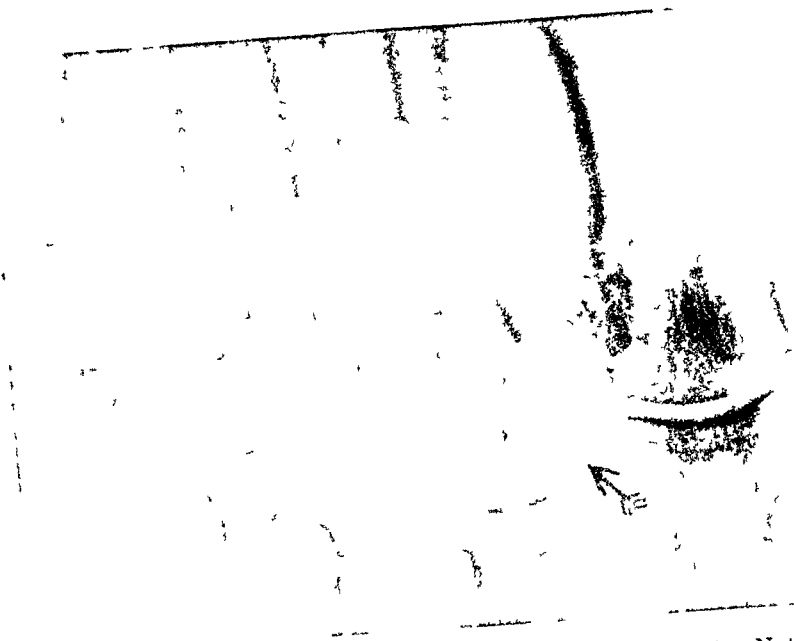


FIG. 5—Infraction (egg shell fracture) of head of second metatarsal. Note flattening of articular surface and compare with normal convexity at heads of uninjured metatarsals (anteroposterior view)



FIG. 6—Lateral view of FIG. 5. Note oblique indentation



FIG. 7 —Fracture of processus posticus tali with fracture of calcaneum. Note diminished density of that part of astragalus from which process is separated (lateral view)



FIG. 8 —Longitudinal fissured fracture of lower extremity of radius. Fracture line extends from inferior articular surface between the quadrilateral and triangular facets, extends 4 cm. upward and outward 4 cm. to disappear 5 cm. internal to outer border of radius.

ence to his article shows that it was the processus posticus tali that was fractured. The same error had been made in the case that I report.

The processus posticus tali is the posterolateral projection of the astragalus, the lateral tubercle of anatomists, which bounds externally the sulcus for the tendon of the flexor longus hallucis muscle.

The os trigonum, or intermedium cruris, on the other hand, lies in the second month of fetal life as an anlage of hyaline cartilage between the distal ends of the tibia and fibula, and has the shape of a triangle with the apex directed proximally and the base distally. Normally it remains independent for only a short time, uniting to the astragalus. In 3 per cent of cases it persists as an independent bone. Aside from man it is found among mammals only in the wombat. When persisting it is always situated behind the astragalus, from which it is separated by a slight fissure, and is oval in form, measuring 20 by 15 mm. It is present on both sides, and has the peculiarity of being usually rudimentary on one side.

He had not been able to find an instance of fracture of the os trigonum. The question is whether the fragment found is a fractured processus posticus tali or a normal, though inconstant, os trigonum. A study of the skiagram shows a definite vertical plane of fracture, with diminished density of that part of the astragalus from which the processus posticus was broken off.

LONGITUDINAL FISSURED FRACTURE OF LOWER EXTREMITY OF RADIUS

DR SKILLERN presented a skiagram which he said was obtained in the Surgical Out-Patient Department of the University Hospital, but the patient did not report after visiting the Receiving Ward, probably because of slight symptoms, and therefore no history was obtained. It shows a fissure beginning at the ridge on the inferior articular surface of the radius between the quadrilateral and triangular facets and extending obliquely upward and outward 4 cm to disappear 0.5 cm internal to the outer border of the radius (Fig 8).

This is the ninth case of the injury on record, if we wish to include that reported by Wilhoit (*Jour A M A*, 1913, lxi, 770) as a longitudinal fracture, but which in reality cuts off the ulnar corner of the radius. Writing in 1910, Cotton states "So far as we know this fracture is the result of direct violence by crushing. It is very rare, three specimens constitute the total of the evidence." As in other longitudinal fractures it may be suspected clinically by a line of "wincing" tenderness.

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DISJUNCTION OF EPIPHYSES OF FOURTH AND FIFTH METACARPALS

DR SKILLERN reported the case of a boy, aged fourteen years, who struck another lad with his right fist and reported at the Surgical Out-Patient Department of the Polyclinic Hospital on August 5, 1914. The heads of the fourth and fifth metacarpals were prominent on the dorsum, there were localized œdema and "wincing" tenderness. Skiagram (Fig 9) shows separation of the epiphyses for these bones. Unfortunately a lateral view was not taken. Treatment consisted of reduction with immobilization by a straight palmar splint.

This injury is described by White in Piersol's Anatomy as follows. "Falls upon or striking with the closed fist tend to produce forward displacement. As the metacarpal bones of the index, middle, and ring fingers are the longer, their epiphyses are more likely to be separated in this manner. A fall on the extended fingers and metacarpophalangeal region may cause backward displacement, though this is rarer.

"The diagnosis from dislocation of the proximal phalanges is not easy. It is aided by the recognition of 'muffled crepitus' (Poland) and by the greater tendency of the deformity to recur, due partly to the small articular areas of the separated bones and partly to the action of the flexors and the interossei." Muffled crepitus was obtained in this case during the process of reduction. It was not sought as a diagnostic sign, because the diagnosis was made without this painful manipulation. The injury should not be overlooked, and reduction must be effected, lest the growth of the metacarpal be interfered with.

Coues (*Bost M and S J*, July, 1913) calls attention to epiphyscal disjunction at the base of the first metacarpal.

INCONSTANT EXTRA-EPIPHYSIS AT BASE OF SECOND METACARPAL

DR SKILLERN presented a skiagram (Fig 10) which showed, in addition to the usual epiphysis at the head of the bone, an extra-epiphysis at the base, the centre of which is uniting with the shaft. The epiphysis may also be made out in the lateral view (Fig 11). The writer's attention was called to this anomaly by Dr H. K. Parsonst.

The first is the only metacarpal that has an epiphysis at its base normally, and for this reason it is considered by some as a phalanx, in which the epiphyses are always at the base. There is usually a scale-like epiphysis on the head of the first metacarpal, which makes its appearance about 8 or 10 and rapidly unites with the head. Rarely, smaller epiphyses appear at the bases of the other metacarpals, as in

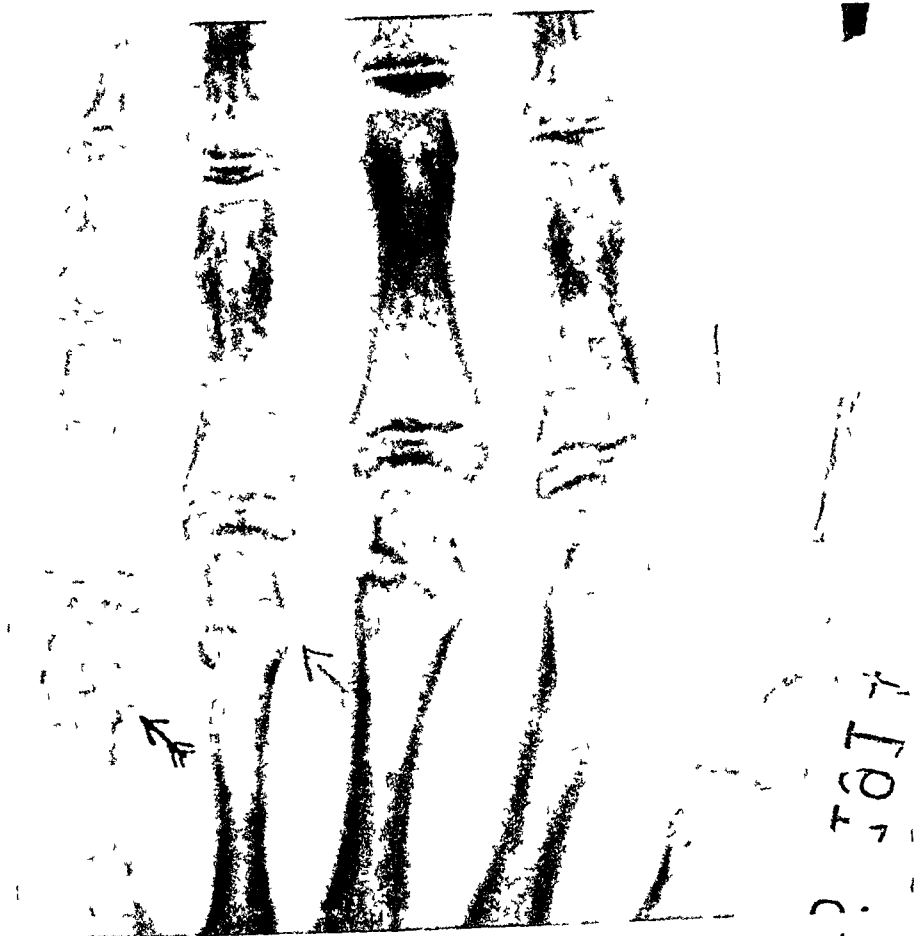


FIG 9 —Disjunction of epiphyses of fourth and fifth metacarpals Displacement shown at distal
end of diaphyses



FIG. 10.—Inconstant extra epiphysis at base of second metacarpal. Union with distal phalanx at centre (anteroposterior view)

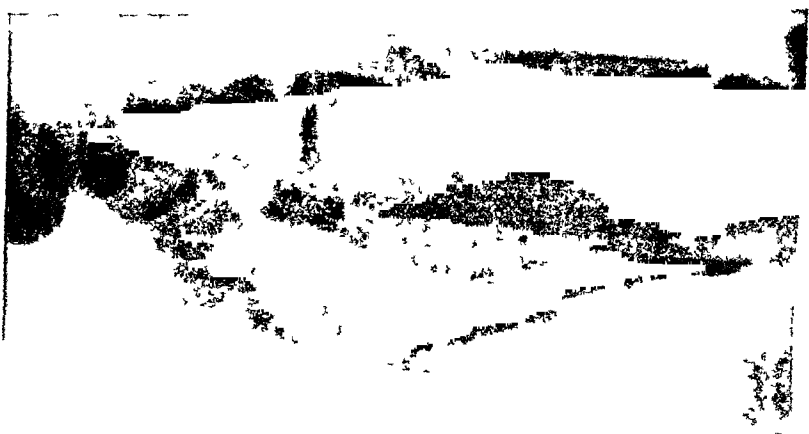


FIG. 11.—Lateral view of FIG. 10



B



FIG 12 —Case I



FIG 13 —Case II

FRACTURE OF BASE OF FIFTH METATARSAL

mammals generally There may be an independent centre for the styloid process at the base of the third metacarpal

FRACTURE OF BASE OF FIFTH METATARSAL

DR MORRIS BOOTH MILLER presented skiagraphs of two patients with fracture of the base of the fifth metatarsal In each the injury was due to indirect violence, the sudden imposition of the body weight while the foot was inverted and the heel raised In this they are in accord with the cases previously reported by Robert Jones, Wharton, Coues, Cotton, Sylvester, and others, which show without exception that indirect stress is the responsible factor in all fractures of this type

I W McC, aged twenty-five, while driving quickly stepped out of his carriage to avoid an accident He stated that he was anxious to reach his horse's head and hence he was in the act of turning when his foot touched the ground He felt a pain on the outer side of the foot but it was not severe and he was able to walk with very little discomfort Diagnosis was by skiagraph which showed a fracture 3 cm from the base (Case I, Fig 12, A and B)

II S F, aged thirty-two, stepped from a ladder upon a hammer, which caused his foot to turn in, while at the same time he made a sudden effort to prevent a fall Pain and partial disability caused him to seek hospital treatment (Case II, Fig 13)

DR PENN G SKILLERN, JR, said the cause of this fracture by indirect violence is a sudden, sharp adduction of the foot, whether by dancing, jumping, or missing the last step of a ladder or staircase Thus, the weight of the body comes down upon the outer border of the foot, turning the head of the metatarsal inward, and bringing a cross-strain to bear just in front of the broad basal portion of the bone, which is held firmly apposed to the similarly broad base of the fourth metatarsal by very strong ligaments Near the front of the broad base the metatarsal gives way (Cotton) There may be a fissure of the outer side only or a clean break across Pain is not great, and the immediate disability is only partial By pressing the neck of the bone inward pain is caused at the base "The alternative of fracture of the fifth metatarsal bone near its base by indirect violence is a luxation at its proximal articular surface, the avulsion showing as a distinct cleft in the skiagram"

The tuberosity at the base may be avulsed by the pull of the tendon of the peroneus brevis muscle In 600 fractures Lihenfeld (*Archiv. f. klin. Chir.* 1905-1906, 78, 929) found isolated fracture of the tuberosity but 5 times This fracture must not be confused with the

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presence of an *os vesalianum*, first described by Vesal. This is either an extratarsal bone of a persisting epiphysis situated at the proximal and external part of the tuberosity. It is a shell-like bone, marked off by a groove on the plantar surface. It is not present beyond puberty. Like the *os trigonum*, it is exceedingly rare, and occurs on both sides. Coues (*Bost M and S J*, May, 1914) reports a case in which the *os vesalianum* was present.

BULLET LOCALIZER

DR DAVID R. BOWEN presented a new bullet localizer which he said, to be precise, was a new attachment to a localizer now in use.

The idea of using cross threads to replace the course of Röntgen rays and thus localize a foreign body originated with Mackenzie-Davidson of London.

Later, Mr. Edwin Kelly added the pointer rod which is now in general use.

Given a surgeon and a roentgenologist used to working as a team this has served well. Many, indeed very many, cases have arisen, however, in which, after the localization was made, the rod was found to point through an undesirable site for operation. The fact that this was usually due to faulty team work or inexperience in no wise lessened the annoyance. The device here exhibited aims to remove entirely the personal equation and to make the localization a matter of precision.

It is original, I believe, in that from a single Mackenzie-Davidson localization variations can be made at will without further roentgenization. It is also original in that an actual probe is a part of the apparatus.

The instrument consists of a series of aluminum bars joined together by thumb nuts so as to make a four-jointed bar, fifteen inches in length, capable of universal motion in a single plane. At one end is a clamp which fits the Kelly pointer rod, while the opposite end carries a tubular probe carrier.

To use, the clamp is fitted to the rod at a distance above a permanent mark on the rod equal to the distance of the F. B. below the end of the rod, as determined by the usual method. The joined bar is then adjusted so that the probe will just touch the end of the pointer rod.

It is obvious that, if, now, the clamp is moved down to the mentioned permanent mark, then the probe will point directly at the foreign body, that an indicator attached to the probe will indicate the depth of the F. B. in that direction just as does the indicator on the Kelly pointer, and also that the direction of the pointer can be changed repeatedly at will (see Fig. 14, A and B).

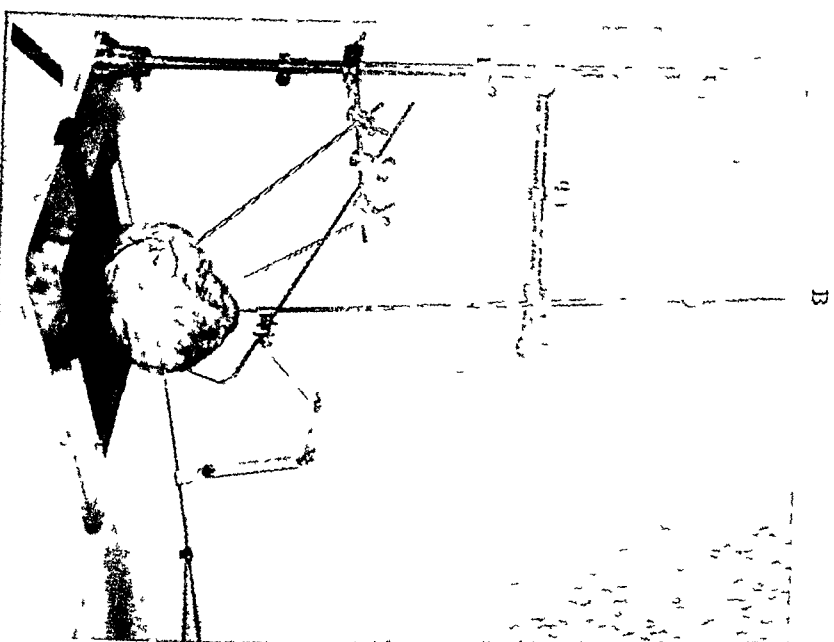
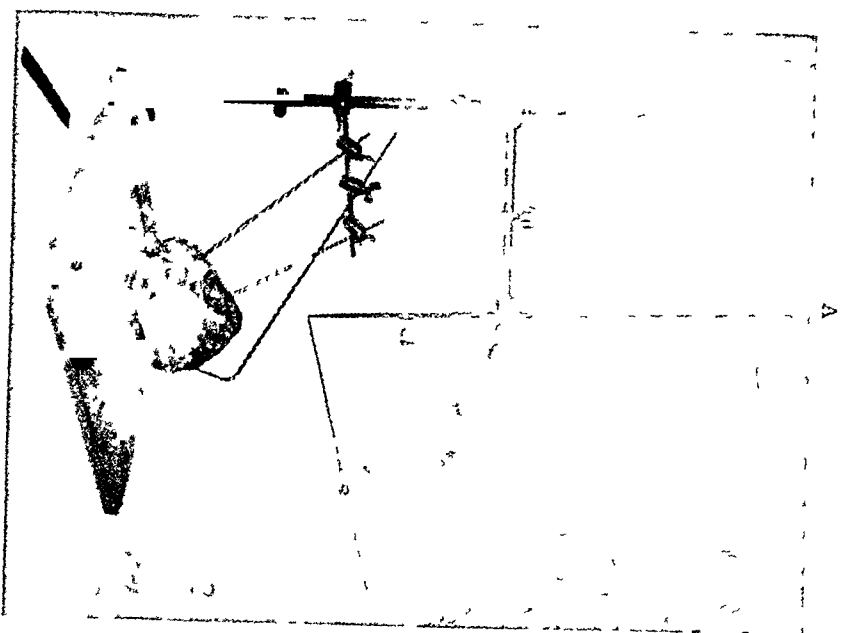


FIG 14—A shows the attachment adjusted so that the end of the probe meets the end of the pointer rod. In B the clamp has been lowered on the pointer rod the specified distance. X is the indicator on the probe, Y the tubular carrier, W show the attachment complete. In B the distance between X and Y is the distance from the end of the probe to the foreign body.

BOOK REVIEWS

DISEASES OF THE RECTUM AND COLON AND THEIR SURGICAL TREATMENT By JEROME M LYNCH, M.D 8vo, pp 583 Lea and Febiger, Philadelphia.

DISEASES OF THE RECTUM AND ANUS Edited by A. B COOK, A M, M D F A Davis Co, Publishers 8vo, 610 pages

These two works on rectal diseases are dedicated to Mathews and Tuttle, whose teaching they honor, augment and perpetuate

The volume by Lynch has extended its field from that of proctology to include diseases of the colon. Such an extension of scope without increase of text has been accomplished at the expense of detail and completeness

In addition to the usual chapters entitled, Examination and Diagnosis, Hemorrhoids, Fistulæ and Fissures, there are several chapters that offer well arranged material of practical value to the reader These cover the subjects of cryptitis, papillitis, diverticulitis and radiographic examination of the bowel Particularly noteworthy is the contribution by Dr Maxwell Telling of Leeds on the pathology and differential diagnosis of parasigmoid infections of diverticular origin Frequent errors in mistaking these benign sigmoid infections for malignant neoplasms and the infrequency of their discussion in books on the rectum renders this reference of particular value

The chapter on symptomatology and diagnosis of neoplasms of the colon includes all the cardinal subjective and objective findings that characterize a well-established lesion, but falls a little short, perhaps, in elucidating that early evidence upon the recognition of which so much of the success of operative relief surely depends Scant attention is given systematic, intelligent palpation, inspection, auscultation and percussion of the abdomen, and none to the physical and chemical examination of fæces, or to disturbances in contiguous organs and tissue One notes with pleasure, on pages 242-244, the recognition of the high enema fallacy and a means of overcoming this difficulty without the use of a long rectal tube and high pressure The publisher's care and skill are recognized in attractive binding, clear typing and illustrations

The volume, edited by A B Cook of Los Angeles, is composed of articles written by several authors, each recognizably competent

BOOK REVIEWS

in the special field selected. The first 294 pages are by the editor himself, and cover the subjects of general diagnosis, examination, constipation, pruritus, proctitis, and ulcerative processes and infections, hemorrhoids and prolapse. Chapters on local anæsthesia and the relation of rectal diseases to general health offer suggestions of value in a progressive phase of proctology. Recto-colonic alimentation is still held up as scientific therapeutic procedure, despite recent testimony as to the physiological availability of food materials thus absorbed. Under the heading, Rectal Pathology Due to Extra Rectal Causes, no mention is made of chronic parasigmoid infections of diverticular origin.

WILLIAM C WOOLSEY

THE CANCER PROBLEM, by WILLIAM SEAMAN DAINBRIDGE, M.D., Professor of Surgery, New York Polyclinic Medical School and Hospital, etc. New York: The Macmillan Company, 1914. Octavo. 534 pages.

In this book the author has assembled from many sources data bearing upon the subject of cancer in such a way as to give a comprehensive résumé of present knowledge with reference to cancer. It is evidently intended to be a book of reference, not especially for the use of surgeons any more than for the use of the general practitioner or by the intelligent layman who is interested in health matters.

After a brief chapter detailing the development of the methods for cancer research that are being pursued both in this country and abroad he passes on to a statement of facts with regard to the distribution of cancer, embracing its zoological, ethnological, and geographical relations.

The theories which have been advanced by various scientists as Virchow, Thiersch, Waldeyer, Cohnheim, Ribbert, Hauser and others are briefly stated, only to end in the rather discouraging conclusion, which is only too true, that all the theories that have been advanced are insufficient, and that the true or even a satisfactory working explanation of the nature of cancer has not yet been discovered but that the outcome of all study to date has been simply to emphasize the importance of the removal of all possible sources of chronic irritation, and of benign neoplasms which are subjected to irritation in the effort to remove predisposing causes of cancer.

A full and well-illustrated chapter on the histopathology of carcinoma is given. Chapters follow devoted to the clinical course of cancer, diagnosis and possible errors in diagnosis.

A most important and interesting series of observations are con-

BOOK REVIEWS

tained in Section IX which records the result of investigation upon modern cancer cures in which are detailed investigations as to the value of the enzyme treatment, of the use of serum from birds of prey, of "Cancroidin," of the Otto Schmidt Serum, of the toxins of the micrococcus neoformans (Doyen's Serum), Chian Turpentine, soap solution and ox-gall, molasses, violet leaves and various quack cures, etc , etc , the section ending as was to be expected with the statement that the examination of the many agents and methods which have been employed in the treatment of cancer leads only to a reiteration of the statement that, in the present state of knowledge, surgery offers the only dependable hope of cure

Then follows a description of more modern resources for treating cancer, under the title of Physiotherapy, including in this class the Rontgen rays and radium, destructive fulguration and the various applications of the electrical current, in all of which the results in some cases had been sufficiently encouraging to warrant further work along the lines mentioned. The author sums up this part of his book by saying that the surgery of to-day offers to cancer patients a greater chance of recovery than ever before, and a degree of increased comfort when cure is no longer to be hoped for

A general bibliography of the subject closes the volume together with a very full index, both of authors and of subjects

The author has placed all surgeons under obligation to him for the manner in which he has brought together, within the covers of a book of moderate size, so much information upon a theme of which there is none of higher interest to surgeons nor to the human race

LEWIS S PILCHER.

CORRESPONDENCE

THE RED STIPPLING SIGN OF GASTRIC AND DUODENAL ULCER

TO THE EDITOR OF THE ANNALS OF SURGERY

DURING the last seven years I have recognized the importance of this sign in the diagnosis of chronic ulcers at operation, and have demonstrated it in the operating theatre to generations of residents and dressers. I referred to it in print four years ago¹

In the article on Surgery of Stomach and Duodenum contributed to Choyce's *System of Surgery*, vol. 11, 1912, it will be found mentioned on the following pages 344, 352, 365, 388

It is one of the most characteristic signs and one on which I lay the greatest stress. It is often visible without the slightest stimulation, but in cases in which there is any doubt gentle rubbing with a gauze swab will cause it to become prominent. It is particularly well marked in a chronic duodenal ulcer situated on the first part of the anterior surface, and often surrounds the ulcerated area as a ring of red speckling.

JAMES SHERRIN

London, England, November 3, 1914

TO THE EDITOR OF THE ANNALS OF SURGERY

THE red stippling sign of gastric and duodenal ulcer, described by Dr. Charles L. Scudder of Boston, Mass., in *ANNALS OF SURGERY*, October, 1914, page 534, I believe has some value and is probably present in a high percentage of cases. As a help to differentiate between ulcer and cancer, I cannot say of how much value it may be, as it had never been brought to my attention until Dr. Scudder's article came out in the *ANNALS OF SURGERY*.

Since reading Dr. Scudder's article I have been able to demonstrate the red stippling in three cases of ulcer, namely, two of the pylorus and one of the lesser curvature.

I realize that three cases are too few to form any definite conclusion, but I think they may help to bring out the point that Dr. Scudder

¹ Clinical Journal, October 26, 1910, p. 35



FIG 1 —Bilateral congenital absence of the radius



FIG 2 —Skigram showing bony condition present in FIG 1

CORRESPONDENCE

wished to make. If we can prove this sign is usually present in ulcer and not present in cancer, it will be of unlimited value to help one to make a differential diagnosis at the time of operation.

HERBERT O. BENNETT

Framingham, Mass., November 12, 1914

BILATERAL CONGENITAL ABSENCE OF THE RADIUS

EDITOR ANNALS OF SURGERY

THE following case of deformity of both forearms present since birth was referred to me recently by Dr. Wm. Burt, of Paris, Ont.

The patient is the fifth child of apparently healthy parents. The first child is healthy and perfectly normal. The second baby had a very similar deformity of both arms, and died of inanition (?), when seven weeks old. The third and fourth children are healthy.

Present Condition—A fairly well nourished baby, with a papulo-squamous eruption on the skin of the face and neck and of the scalp. The upper arm on each side is normal. The hands appear as stubs to the outside of the elbow (Fig. 1). On palpation the ulna can be felt projecting downward from the elbow, along the inner side of the wrist, and impinging on the skin near the inner angle of the metacarpus.

The radiogram (Fig. 2) shows total absence of both radii, without any other congenital deformity. The metacarpal bones are perfect in number and development. The deformity is due to *bilateral congenital absence of the radius*.

From the presence of a similar deformity in another child, of a typically syphilitic dermatitis, and of a distinct thickening of the cortical bone in the phalanges of the mother's hand, I am inclined to believe that congenital syphilis has had a causative influence.

Brantford, Canada

EDWARD REGINALD SECORD, M.D.

STRANGULATED INGUINAL HERNIA CONTAINING CÆCUM AND APPENDIX

EDITOR OF ANNALS OF SURGERY.

As a contribution to the question of strangulated hernia containing the appendix vermiformis, suggested by the case presented by Dr. Downes at the meeting of the N. Y. Surgical Society, November 25, I desire to report the following case which was under my own observation.

The patient, a man forty-five years of age, was admitted to the Harlem Hospital on January 12, 1908. For twenty years there had

been present a right inguinal scrotal hernia, no effort to control which had been made. One week before admission this was contused by the stroke of an iron bar. Severe pain followed, which continued, and at the end of a week he began to vomit, although the bowels had moved every day with the aid of cathartics.

When admitted there was an elongated mass extending from the external abdominal ring on the right side to the bottom of the scrotum, which mass was irreducible, and for an area of two or three inches around the external ring there was marked tenderness. Incision exposed a sac greatly thickened from inflammation. When it was incised a large amount of pus escaped. Within the sac, after the escape of the pus, there was found to be present the cæcum with the appendix. The distal end of the appendix was in the abscess. The appendix was removed and the intestine returned after enlargement of the neck of the sac. The sac was amputated and the stump returned to the abdomen. The cord and testicle upon examination were found to be much inflamed and at a number of places gangrenous. They were removed. The usual operation for radical cure of hernia was then done, the wound being closed with one drain in the inguinal region and another in the scrotal. Although some suppuration followed in the scrotal portion of the wound, he was discharged well at the end of four weeks. Patient has been examined by me recently and still remains well. There is no hernia.

New York City, December 8, 1914

JOHN F. CONNORS, M.D.

ENDOTHELIOMA OF THE INTERCAROTID BODY

EDITOR ANNALS OF SURGERY.

We desire to place on record the following case. A colored soldier of the United States Infantry, who had always been in good health without history of pulmonary or syphilitic disease, presented himself with a tumor on the left side of the neck, the presence of which had been known for over a year. It had been painless until within a few weeks. Now turning the head to the left produces pain in the tumor. Deglutition somewhat painful and difficult on account of the swelling in the left side of the neck. Tuberculin test was negative, luetin test was negative; urine was normal. He was a well-developed man without any evidence of anemia, emaciation, syphilis or tuberculosis. The inguinal postcervical lymph-glands are palpable and small, movable and painless. Teeth in good condition, tonsils somewhat enlarged, not inflamed. In the left side of his neck in the upper portion of the anterior triangle is

CORRESPONDENCE

a solid tumor the size of an egg, movable, slightly tender, slight non-expansive pulsation When head is bent toward left shoulder, the tumor is pressed upon by the angle of the jaw, causing pain

Operation (March 19, 1914) —Ether Incision along anterior border of sternomastoid External jugular vein presented in wound and was ligated On opening fascia a small solid tumor, size of pigeon's egg—like a lymph-gland—was exposed This was dissected free of its attachments to surrounding tissues and was found to be part of a larger tumor beneath The smaller upper portion was removed and the tumor beneath was found to be bounded on two sides and below by a large pulsating vessel This was found to be the bifurcation of the carotid artery, though it lay more superficially than normal—probably lifted up by growth of tumor which was closely attached to the walls of all three arteries Tumor was of bluish color, very vascular, and with moderately firm capsule Its appearance was that of a thyroid gland. Tumor removed from walls of arteries by sharp dissection Hemorrhage quite free, especially from several points in walls of carotids. Clamps applied and left in place Wound packed with gauze

March 22, 1914 Clamps removed and wound sutured

March 29, 1914 Sutures removed, primary union

April 26, 1914 Returned to duty Condition good

September 25, 1914 No recurrence to date

REPORT ON THE PATHOLOGICAL EXAMINATION OF INTERCAROTID TUMOR (BY CAPT I H FOUCAR)

1 An irregularly oval piece of tissue, grayish-yellow in color, consistence firm, cut surface smooth and homogeneous The dimensions were 2.5 by 1.3 by 3 cm The weight 2.2 gm

2 *Microscopical Examination*—The capsule was thin and sent in a few trabeculae, dividing the gland into lobules The specimen was seen to consist mainly of strands of endothelial cells, the arrangement of these strands of cells varied in different parts of the tumor, those in the cortical part of the tumor were arranged more or less parallel to the surface, the subcortical strands were finer and arranged perpendicularly to the surface, in the medullary portion, the endothelial strands were arranged in irregularly anastomosing plexi

3 The spaces between the columns of endothelial cells were occupied by the following structures (a) stroma, (b) parenchyma, (c) blood-spaces

4 *Stroma* consisted of very little fibrillated connective tissue, most of it being represented by branching polygonal cells with large vesicular nucleus and faintly staining cytoplasm, the branching processes of these plasma cells, joining with semiprocesses of neighboring cells, formed spaces, some of which contained red blood-cells

5 *Parenchyma*—Between many of the trabeculae of endothelial cells were closely packed masses of small cells, these cells presented a small amount of deeply staining cytoplasm, and a relatively large, deeply staining, oval nucleus,

CORRESPONDENCE

they were arranged in narrow, irregular masses between the strands of endothelial cells, with here and there a suggestion of alveolar arrangement

6 *Blood-spaces*—No well-formed blood-vessels were noted in the entire specimen sectioned, their places were taken by irregular channels, lined with endothelium, which in places was much thickened

7 No giant-cells were noted, a few karyokinetic figures were noted in the cells of the parenchyma of the gland The stain used was alum hematoxylin-eosin

8 *Diagnosis*—Endothelioma arising from an intercarotid rest

Honolulu, Hawaii, December, 1914

L J OWEN, M D,
Captain, Medical Corps, U S A

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THE OPERATIVE TREATMENT OF CARCINOMA OF THE ŒSOPHAGUS*

BY FRANZ TOREK, M.D.

OF NEW YORK

WITH the exception of some successes in the cervical portion, the treatment of carcinoma of the œsophagus has, until recently, been a total failure and is still very unsatisfactory. Though definite proof of the possibility of successful surgical removal of the carcinomatous œsophagus has been furnished within the last two years, nevertheless, even at the present day, cases, as they are brought to the attention of the surgeon, are almost invariably in an advanced stage of the disease. This is accounted for by the fact that the patients afflicted with this disease consult their physicians mainly on account of one solitary symptom, the inability to swallow solid food, and that is a late symptom. Pain on deglutition, or independently of swallowing, is also a late symptom. In early and even moderately advanced cases there is, as a rule, no pain, when that symptom occurs, it usually signifies that the disease has extended beyond the limits of the œsophagus and that operative removal is no longer to be considered. The absence of symptoms previous to the time when the passage has become obstructed explains why, at the present time, an early case of carcinoma of the œsophagus is practically unknown to the surgeon. The earlier symptom, temporary disturbance of deglutition, probably due to inflammatory swelling in the vicinity of the small carcinoma, does not receive serious attention on the part of the patient, and, when the swelling has subsided and deglutition is again unimpeded, he will not be inclined to consent to an operation, particularly not an operation involving considerable risk. Thus it happens that the great majority of cases of carcinoma of the œsophagus that we see are inoperable.

Diagnosis—It is not the object of this paper to enter into the details of the diagnosis of the disease. Let it suffice, therefore, to say that besides the subjective symptoms mentioned above we gather the information derived from the passage of sounds, from roentgenograms, and

* Read before the New York Surgical Society, November 25, 1914

by œsophagoscopy to aid us in determining the presence and location of the carcinoma. However, I wish to call attention to the danger of removing a section for pathological diagnosis. By this procedure, especially if it is repeated, a slowly growing tumor may be stimulated to more rapid growth.

Operative Results—The cervical portion of the œsophagus has been attacked surgically a number of times with a successful issue as far as recovery from the operation is concerned. One case was reported by v. Hacker, 1½ years after operation, to be free from recurrence, all other cases died from recurrences of the disease.

The resection of the abdominal portion of the œsophagus has been attended with success three times—Volcker in 1907, Kummel in 1909, and Zaaijer in 1913. Of these three, however, the œsophagus was not affected in the first two, they were carcinomata of the cardiac end of the stomach, the removal of which required resection of the abdominal portion of the œsophagus. In Volcker's case, a woman sixty-four years old, the obstruction was met at a distance of 46 cm from the incisors, an exceptionally long stretch, when we consider that the average distance from the teeth to the cardiac end of the œsophagus in women is below 40 cm. Kummel's case, likewise, is described as a carcinoma of the cardia pure and simple. He sutured the œsophagus to the stomach over the two arms of a T-tube, the leg of which was brought out of the abdominal wound for purposes of feeding. Although it may be difficult, perhaps sometimes impossible, to make a sharp anatomical distinction by gross inspection, whether a carcinoma of the cardia has or has not involved the lowermost end of the œsophagus, this question is of practical importance only where the œsophagus is distinctly involved, for it certainly does make a difference, in the technical aspect of the task before us, whether the œsophagus is involved or not. Volcker and Kummel operated entirely from the abdomen, a procedure which requires the œsophagus to be liberated out of the hiatus œsophagus and drawn down as much as possible into the abdomen. These two surgeons describe the great difficulty they experienced in bringing the œsophagus down far enough to suture it to the stomach. In case of an involvement of the œsophagus itself this difficulty would, of course, be much increased, and it would be well-nigh impossible to liberate the œsophagus and bring it down far enough to operate from the abdominal side. In Zaaijer's case, likewise one of carcinoma of the cardiac end of the stomach, the lowermost portion of the œsophagus is described as being involved, although in his case also the bougie met the obstruction low down, 45 cm from the teeth, i.e., a few centimetres lower than the

CARCINOMA OF THE ŒSOPHAGUS

average distance of the lower end of the œsophagus from the incisors Zaaier did not operate through the abdomen alone, but by a combined abdomino-thoracic method to be described later. Therefore, while we acknowledge that Volcker's and Kummel's operations were very remarkable surgical achievements, it is but just to credit the first successful removal of a carcinoma of the abdominal portion of the œsophagus to Zaaier.

Carcinoma of the thoracic œsophagus has been operated on successfully but once, my own case. the patient is well and free from recurrence, 20½ months after operation. It should be mentioned, however, that a few cases have lived about two weeks before they succumbed to the results of the operation.

Anatomical Points.—Before proceeding to the description of the operative methods it may be well to call to mind a few anatomical points. In the neck, the œsophagus lies in front of the spinal column and behind the trachea, a little farther to the left than that organ. In the thorax the same relation obtains, except that the œsophagus deviates a trifle more to the left. Near the bifurcation of the trachea the transverse portion of the arch of the aorta is encountered, which, here, is separated from the œsophagus by the trachea. Then, as the arch of the aorta crosses the left bronchus, it lies to the left of the œsophagus and the upper part of the descending aorta lies behind and to the left of the œsophagus. Considering the relative position of the three organs, aorta, trachea or bronchus, and œsophagus, the aorta has passed from the front to the rear, so that the œsophagus now lies between the left bronchus and the aorta. Farther down, the œsophagus crosses over in front of the aorta to take its position to the left of that vessel in the lower part of the thorax. The aorta therefore may be said to twist spirally around the œsophagus.

The œsophagus receives its blood supply in the neck from branches of the inferior thyroid arteries, in the chest, from branches of the bronchial arteries and from the aorta itself, in the abdomen, from branches of the left gastric artery.

The lumen of the œsophagus is normally narrowed to some extent at certain places. The first narrowing is at the beginning of the œsophagus, behind the cricoid cartilage, the second, at the bifurcation of the trachea, the third, at the hiatus œsophagus of the diaphragm, or slightly above it. There may or may not be a narrowing at the upper thoracic aperture.

The average measurements according to v. Hacker are. For males, from the incisors to the beginning of the œsophagus, 15 cm., to the bifurcation of the trachea, 25 cm., to the cardia, 40 to 41 cm. For females, the figures are, respectively, 14, 24, and 38 to 39 cm. Variations of several centimetres, however, are not rare.

In the neck, the recurrent laryngeal nerve runs upward in the gutter between the œsophagus and the trachea. The structures in front of the lateral border of the œsophagus are the skin and superficial fascia, the platysma, the sternocleidomastoid, sternohyoid, and omohyoid muscles, the thyroid gland, and the middle layer of the deep cervical fascia which is continuous with the capsule

of the thyroid gland mesially and with the sheath of the great vessels laterally. Attention to the deep cervical lymphatic nodes is of importance in cases of carcinoma of the cervical portion of the œsophagus. There are two sets of nodes, the superior, along the upper part of the internal jugular vein, in the neighborhood of the bifurcation of the common carotid artery, and the inferior situated along the lower part of the internal jugular vein and in the supraclavicular fossa, mainly in the angle formed by the subclavian and internal jugular veins. The inferior lymphatic nodes are usually affected later than the superior. On the left side the proximity of the thoracic duct to the inferior nodes, and the possible danger of wounding it, must be kept in mind.

In the thorax the thoracic duct lies behind the œsophagus in its upper part but is rarely in direct contact with it, lower down, where the aorta pushes the œsophagus forward, the thoracic duct lies behind the aorta.

The pneumogastric nerves are in relation with the œsophagus from the arch of the aorta downward. The left vagus lies on the left and anterior wall of the œsophagus, the right nerve, on the right and posterior wall. In the lower half of its intrathoracic course the pneumogastric ceases to be a single nerve and divides into a number of anastomosing nerves, forming the anterior and posterior œsophageal plexuses.

The relation of the pleura to the œsophagus is different on the right side from that on the left. On the right side the pleura envelops the œsophagus, insinuating itself to some extent between the œsophagus and the spinal column, especially in its middle portion, causing the œsophagus to stand out more prominently than on the left side. It appears as if the right pleura were making a faint attempt to provide the œsophagus with a serous coat. On the left side the œsophagus does not stand out, the prominent features are the pericardium in front of it and the aorta behind it, the œsophagus lying in a depression between the two, manifesting itself only by a slight bulging, and even this may be absent. The pleura, on the left side, makes no attempt to envelop the œsophagus but simply passes from the pericardium across the œsophagus to the aorta which latter it envelops in part.

Resection of the Cervical Portion of the Œsophagus—A preliminary gastrostomy should be done to improve the patient's nutrition and enhance his powers of resistance, so as to render him better able to withstand the hardship of the operation. Subsequent to the operation the gastric fistula also protects him against some of the dangers of wound infection and other insults incident upon feeding through the cervical wound. By the elimination of feeding through the wound the dressing is also greatly simplified (compare my article, *Laryngectomy Combined with Gastrostomy, Surgery, Gynecology, and Obstetrics*, April, 1914).

The tumor must be removed by a circular resection of the œsophagus in lines at least 2 cm distant from each end of the carcinoma. The deep cervical lymphatic nodes, that are affected or suspected of being involved, should be removed either at the time of the operation or at a later sitting. In advanced cases it may be necessary also to remove the larynx and part of the trachea. Great care must be exercised to

CARCINOMA OF THE ŒSOPHAGUS

avoid injury to the recurrent laryngeal nerves, the jugular and subclavian veins, and the thoracic duct

As a rule, an attempt should be made to restore the œsophagus. One way of doing this (Ach's method) is to take a large broad skin flap from the neck (Fig 1) and turn it upon itself so as to form a tube (Fig 2), with the skin side inward. The two ends of this tube are sutured to the upper and lower divided ends of the œsophagus. The œsophageal tube is thus restored, except at the side, where the edge of the flap is turned back upon the flap. This part is tamponed, it is closed about two weeks later, and the raw surface is covered by a skin plastic.

Another method is v. Hacker's. In the first stage of this operation the skin flap is placed into the depth of the wound to form the posterior wall

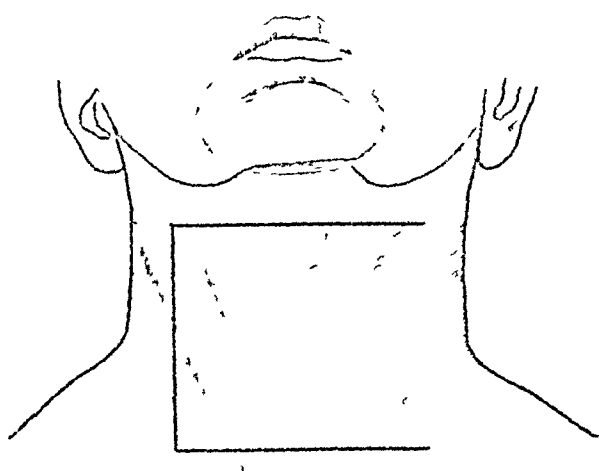


FIG 1.—Resection of cervical œsophagus. Outline of flap for construction of new œsophagus. Ach's method.

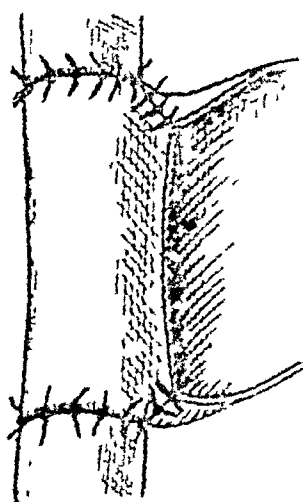


FIG 2.—Flap outlined in Fig 1 rolled up to form a tube, skin surface inside. One side of the tube, however, remains open. This is closed a subsequent operation.

of the œsophagus (Fig 3). The posterior halves of the upper and lower œsophagus stumps are sutured to the upper and lower borders of the flap, respectively. In the second stage, a skin flap is shaped on each side of the newly-made posterior wall of the œsophagus, and the two flaps are turned toward each other, edge to edge, and united to form a tube (Fig 4). The tube, in turn, is covered by lateral skin flaps (Fig 5) mobilized for the purpose.

The mortality is about 36 per cent, the most frequent causes of death being insufficient nutrition and resistance of the patient, cardiac failure, pneumonia, exhaustion, and wound infection causing sepsis or peri-œsophageal phlegmon and mediastinitis. Failure to achieve permanent cures is chiefly due to the advanced stage of the affection, many

cases having progressed beyond the œsophagus, involving especially the larynx and trachea. Failure to remove all affected lymphatic nodes is also a cause of unsatisfactory permanent results.

Resection of the Thoracic Portion of the Œsophagus—Previous to the era of differential pressure in intrathoracic surgery, it was the aim to attack the œsophagus by entering the posterior mediastinum without

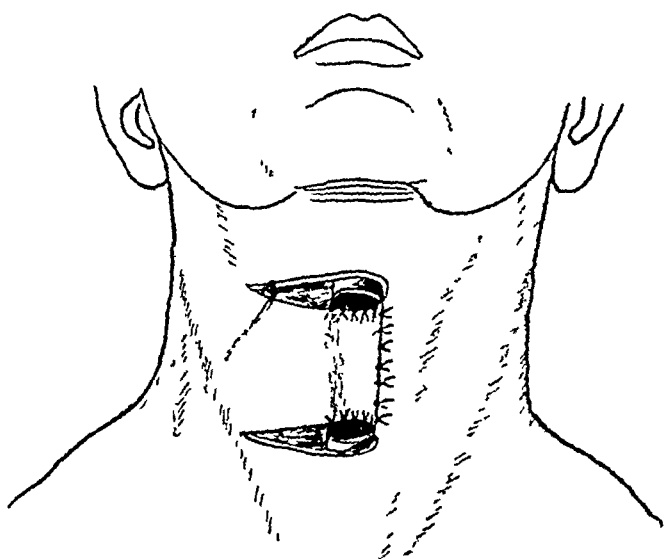


FIG 3—v Hacker's method of œsophagoplasty. Skin flap is sutured above and below to posterior border of upper and lower stumps of œsophagus to form posterior wall of new œsophagus. In this and the two following figures, for the sake of simplifying the diagram the trachea has not been represented.

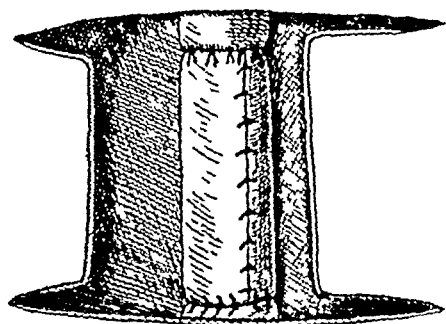


FIG 4—The construction of the œsophageal tube has been completed by turning two flaps, one from each side toward each other and uniting them. One of these flaps is cut smaller than the other.

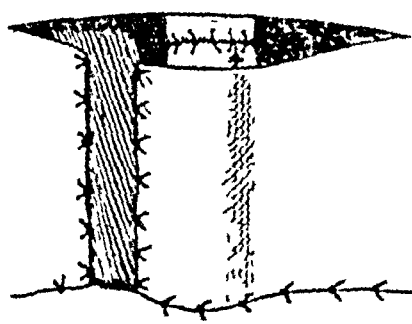


FIG 5—The new œsophagus is covered by a flap from that side from which the trachea was removed. This flap is sutured to the sternocleidomastoid muscle of the opposite side and a flap from the opposite side is attached to the same muscle.

injury to the pleura. L. Rehn elaborated a method consisting in the formation of a flap including the posterior portions of the fourth to the eighth ribs, the flap having its base at the spine. Great caution is to be exercised to keep the pleura intact. Rehn resected a carcinomatous œsophagus by this method, but the issue was unsuccessful. The effort

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at extrapleural resection are still being continued and are being watched with interest. The extrapleural route had been chosen in order to avoid the danger incident to pneumothorax caused by opening the pleural cavity. However, as there now exist methods of keeping the lungs inflated to any desired degree while the thorax is open, the transpleural route of access to the oesophagus is generally preferred.

Differential Pressure—One way of keeping the lungs inflated is by the use of differential pressure, either negative or positive, that is, either the pressure of the air on the outer surface of the lungs is diminished or the pressure of the inspired air is increased. Another way is the method of intratracheal insufflation (Meltzer-Auer) by which the anæsthetic or air is blown into the trachea by means of a catheter introduced through the larynx and attached to a specially constructed pump. The former of these methods requires that the patient's head and his body be in two different chambers, the partition wall being represented at the neck by a rubber cuff which embraces the neck. In my operation for transpleural resection of the oesophagus, in which it is necessary to operate upon the neck also, the presence of this cuff is objectionable. Therefore the method of intratracheal insufflation is employed.

Preparation of the Patient for Transpleural Resection of the Oesophagus—Besides the preparation common to all major operations there is need of attention to certain details. The examination of the heart function is important. A coexisting chronic myocarditis is especially dangerous, arteriosclerosis of the peripheral vessels less so. Cardiac insufficiency requires appropriate treatment for a few days before operation. Anæmia calls for the exhibition of iron and quinine. Even slight catarrhal affections of the lungs require careful pre-operative treatment, such as moist packs and expectorants, possibly in combination with cardinals. Inhalations are efficacious in facilitating expectoration. Existing nose and throat affections should receive appropriate treatment.

Indications for Intrathoracic Resection of the Oesophagus—To consider a case of carcinoma of the thoracic portion of the oesophagus fit for operation it is imperative, first, that no metastases exist. The abdominal organs, especially the liver, stomach, peritoneum, and the retroperitoneal lymphatic nodes are searched for the presence of metastatic carcinoma at the time the preliminary gastrostomy is done. Second, as a rule, the disease should be circumscribed and limited to the oesophagus. An extension of the tumor to the neighboring organs—aorta, lungs, bronchi, pericardium or thoracic wall—renders the attempt at its removal inadvisable unless the extent of that involvement is so limited that it can also be removed. This question as a rule, will not be decided

until the thorax has been opened. Furthermore, as the operation is a serious one, the patient's powers of resistance should not be too much depressed. Thus, cases of nephritis, chronic myocarditis, marked alcoholism, cirrhosis of the liver, etc., are poor subjects for the operation, also patients who fail to gain in weight after the preliminary gastrotomy has been done, or even continue to lose in weight, are unlikely to do well after the thoracic operation.

Methods of Operating Other Than My Own—It is not my object to give an exhaustive account of all the methods of resecting the œsophagus that have been attempted. I shall merely touch upon the more important phases of some. For carcinoma of the lower part of the œsophagus there is Sauerbruch's method of anastomosis of the upper stump with the fundus of the stomach. Through an intercostal incision the œsophagus is freed from the diaphragm, which is divided sufficiently far to permit drawing a portion of the stomach into the thorax. The tumor is resected and the œsophagus anastomosed with the fundus of the stomach by the aid of Payr's tube or Tiegel's button. The stomach is then sutured to the diaphragm.

The cardinal error in these methods lies in the application of the principles of intestinal anastomosis to the œsophagus, an organ which possesses no serous coat. No plastic exudate will be thrown out from the muscular coat of the œsophagus, and we must expect, therefore, that when necrosis of the turned-in ends takes place, they will separate. In the case of the œsophagus we would have to depend for anastomosis, upon a most accurate suture of raw surface to raw surface, and that is a rather difficult task.

Wendel's abdomino-thoracic procedure in cases of carcinoma of the cardia involving the œsophagus consists in Laparotomy through the left rectus, if the case is favorable for resection, extension of the incision through the costal cartilages upward as far as the fifth, opening of the thorax, division of the diaphragm from the rectus incision backward through the hiatus œsophagus. The stomach and œsophagus are then dissected out and brought forward. Resection and anastomosis now follow. On closing the diaphragm, it is sutured to the œsophagus *above* the anastomosis, so that the suture line may be drained abdominally.

Where no anastomosis was possible by any of the above methods, a resection with blind closure of both ends has been done. This has invariably resulted in leakage from the upper stump.

Considerations Leading to the Adoption of My Method—Infection from the œsophagus or the stomach, either at the time of the operation



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or later, through leakage from sutures, has been one of the greatest dangers. The thought that this danger had to be eliminated led to the plan of taking the entire œsophagus, with exception of the well invaginated lower stump, out of the pleural cavity. Another source of infection may have come from the lungs, if they were injured at the operation, in which case the danger of pneumothorax was superadded to that of infection. This called for greater care in handling the lungs and in separating adhesions. The frequent collapse due to vagus reflex demanded more care in handling these nerves. The last two considerations led to the adoption of my thorax incision, which gives good access and permits handling the organs more gently.

Technic of the Operation—The operation is performed in two stages. In the first stage gastrostomy by Witzel's or Kader's method is performed, and the abdominal cavity carefully examined for metastases, in the presence of which the case is not suited for resection of the œsophagus. In the second stage the œsophagus is resected. The patient lies on his right side, with his left arm up and well forward, so that the scapula is out of the way of the line of incision. A cushion is placed under the right side of the chest. An incision corresponding to the entire length of the seventh intercostal space is made through skin and muscles down to the pleura, but not through it, as it is desirable that the pleural cavity does not remain open for an unnecessarily long time and that the hemorrhage from the external wound is attended to before the pleura is opened. From the posterior end of the seventh intercostal space, between the angle and the tubercle of the rib, the incision is carried upward to the third intercostal space (Fig. 6). Skin and muscles are divided, exposing the fourth, fifth, sixth, and seventh ribs. As it is of the greatest importance to preserve the asepsis of the pleural cavity, and as the wound is so large that the possibility of infection from the surrounding parts is greater than in an ordinary wound, the wound is isolated by fastening towels to the edges of the incision with the aid of skin clasps. To insure complete hæmostasis it will be found necessary to clamp and tie many vessels. This first step of the operation may be performed under general or local anæsthesia. I prefer the latter, using a $\frac{1}{2}$ per cent solution of novocaine with suprarenin. Then, while the vessels are being ligated, general anæsthesia is induced. As soon as the patient is under the influence of the anæsthetic the larynx is intubated for intratracheal insufflation anæsthesia. In this way the time during which the patient is under general anæsthesia is shortened.

Anæsthesia is now continued by intratracheal insufflation, and the pleura may be opened without the fear of dangerous collapse of the lung.

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We now have a thorough view of the whole left pleural cavity, and if at the preceding examination there still existed a doubt as to the operability of the tumor, this question is definitely settled at this time. First, we proceed to free the lung thoroughly of all adhesions. This must be done with the utmost care to prevent tearing or cutting the lung. The lung is then laid over toward the front part of the mediastinum and is kept only partially inflated. A full inflation is unnecessary and interferes with the surgeon's work. The use of lung retractors is, as a rule, not recommended. The less the organs are handled, the better. If the lung is inflated to such a degree as to render a retractor necessary, then its use is dangerous, if to the pressure within the lung a pressure from without is superadded, rupture may result, causing the dreaded post-operative pneumothorax. However, if the opposite pleura is opened in the course of operation, a more energetic inflation of the lung is required, for we cannot allow both lungs to collapse. Lung retractors are then needed.

As we stand facing the head of the patient, who is lying on his right side, we see, as prominent features in the lower part of the thoracic cavity, the aorta to our right and the pericardium to our left, the œsophagus lying between them. (It will be remembered that in this region the aorta lies behind the œsophagus and the pericardium in front of it.) The œsophagus is seen only as a slight bulging of the parietal pleura to the side of the aorta. The pleura and connective tissue covering the œsophagus are now divided at some portion where it is not involved, and the œsophagus is lifted out of its bed. A tape or strip of gauze is drawn through underneath it (Fig 8). This serves as a handle to draw the œsophagus forward or to the side, while the dissection proceeds.

The œsophagus is liberated from the surrounding structures all the way up to the upper thoracic aperture and all the way down to the diaphragm, except in cases where the tumor is situated rather high up, when the diaphragmatic end need not be liberated. To determine the extent of the dissection at the diaphragmatic end, we decide at what place below the tumor the œsophagus is to be divided, and allow about 3 cm more for invagination of the lower stump. The dissection is best done with the aid of a blunt instrument, like Kocher's goitre sound, or a long Mayo's dissecting scissors, which is inserted between the œsophagus and the tissues lying over it. The fact that some vagus branches crossing the œsophagus must be divided in the course of this procedure need not deter the surgeon. The main vagus cords will be seen as described under Anatomical Points. Their liberation from the œsophagus is accomplished preferably, not by picking them up with forceps and dissecting

them out with scissors or knife, as one would do in the dissecting room, but by keeping close to the œsophagus and leaving the vagi in their places. An anatomical dissection of the vagi becomes necessary when they are firmly bound down to the tumor. In that case, the one that is less firmly attached is loosened, the other one may be cut. In a general

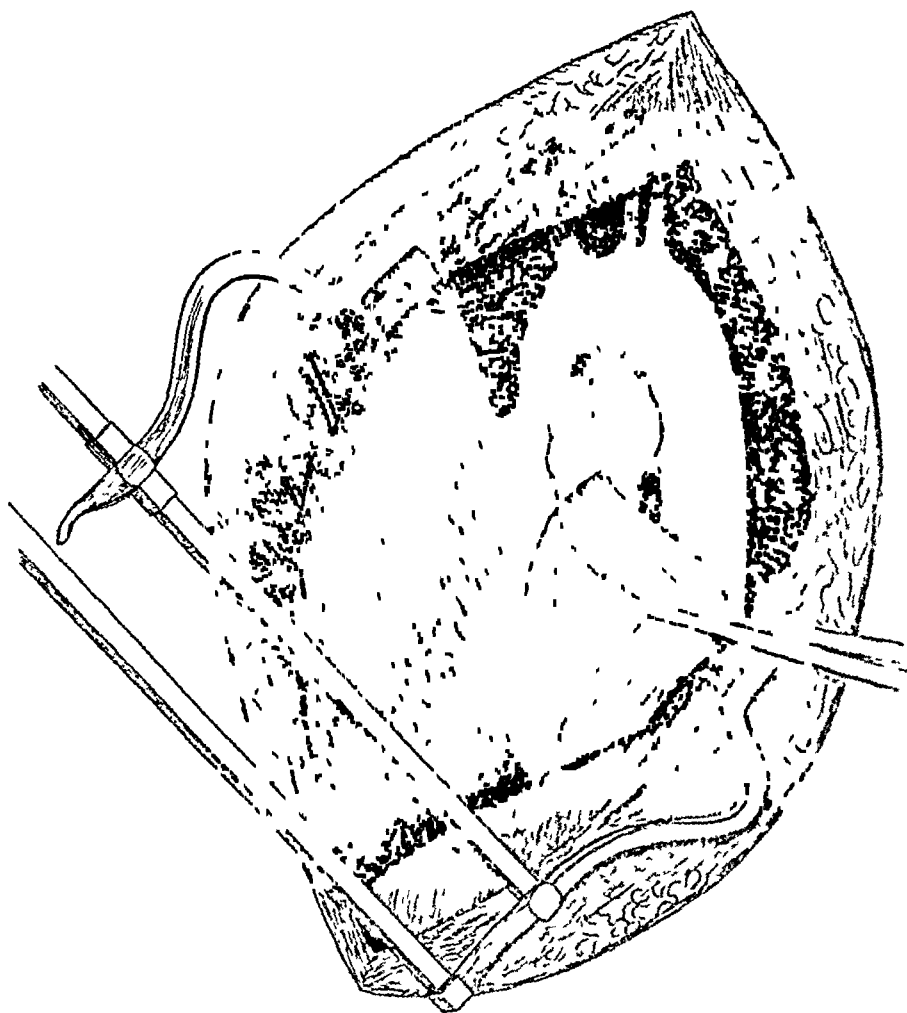


FIG. 8.—Beginning of dissection of the œsophagus. After resection of the pleura covering it the œsophagus is lifted out of its bed and held by a tape passed underneath it. The two vagi have been detached. The tumor is seen below the arch of the aorta. The lung is fairly well collapsed.

way, the less the vagi are handled, the better. Sudden and irreparable collapse has resulted from pinching them or tugging at them.

In releasing the posterior surface of the œsophagus, there is one point to which attention should be directed. After the surgeon has liberated the œsophagus in front and at the two sides, he may perhaps

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be induced to believe that, in liberating the posterior surface, caution is no longer necessary, forgetting that the right pleura is tucked in behind the œsophagus to some extent, especially in its middle portion, as pointed out above under Anatomical Points. In consequence, a tear in the right pleura may result, a rather unpleasant complication, as it necessitates an increased inflation of the lungs, owing to the collapse also of the right lung, and the increased inflation means more encroachment of the left lung on the field of operation.

The dissection of that part of the œsophagus which crosses under the arch of the aorta is not easy. It is done by blunt dissection with the finger introduced under the arch of the aorta and loosening the œsophagus from it and the left bronchus, as well as from its posterior attachments. During this part of the dissection one must be careful not to tug hard on the aorta. The right heart is already working at a disadvantage, as the partly collapsed lung offers more resistance to it than a well-inflated lung, add to this an obstruction to the function of the left heart by pressure on the aorta, constricting its lumen, and a cardiac collapse is apt soon to manifest itself. If the tumor itself is situated in the neighborhood of the aortic arch, as in my successful case, the difficulty of liberating the œsophagus becomes very great. I overcame this difficulty by ligating and dividing a number of the thoracic branches of the aorta and lifting that vessel forward. Here again, in retracting the aorta, one must be careful not to kink it, as the cardiac action will suffer in consequence. The dislodgement of the aorta is of great value in liberating the œsophagus, but in simpler cases, where the tumor did not lie near the arch, I found this procedure unnecessary. Above the arch the œsophagus is liberated, the same as below, by incision of the pleura overlying it, and a tape is again carried around it to serve as a handle for further upward dissection. When the upper thoracic aperture is reached, a finger is carried through it into the neck to the anterior border of the sternocleidomastoid muscle. Here, under its guidance, an incision is made through which the œsophagus is to be brought out afterward. for the time being, a stout silk thread is carried into the pleural cavity through this wound, one end being left outside, to serve for pulling out the œsophagus.

In my opinion, there is an advantage in making this neck incision under the guidance of a finger carried up from the thoracic cavity, even though it may appear inelegant surgery. By digging from below upward, in other words, by employing blunt dissection, less tissue is severed than in the classical mode of approach to the œsophagus, customary in the operation of external œsophagotomy, in which not only a

larger incision is needed but also very often the inferior thyroid artery must be divided to gain access to the œsophagus. In the method of dissecting bluntly from below, that artery remains uninjured, a matter of some importance, as the nutrition of the œsophagus depends in part upon the blood supply from that vessel.

Before proceeding to divide the œsophagus, the surrounding parts are well protected by gauze pads. The œsophagus is tied off with a strong silk ligature at a safe distance below the tumor, and a second

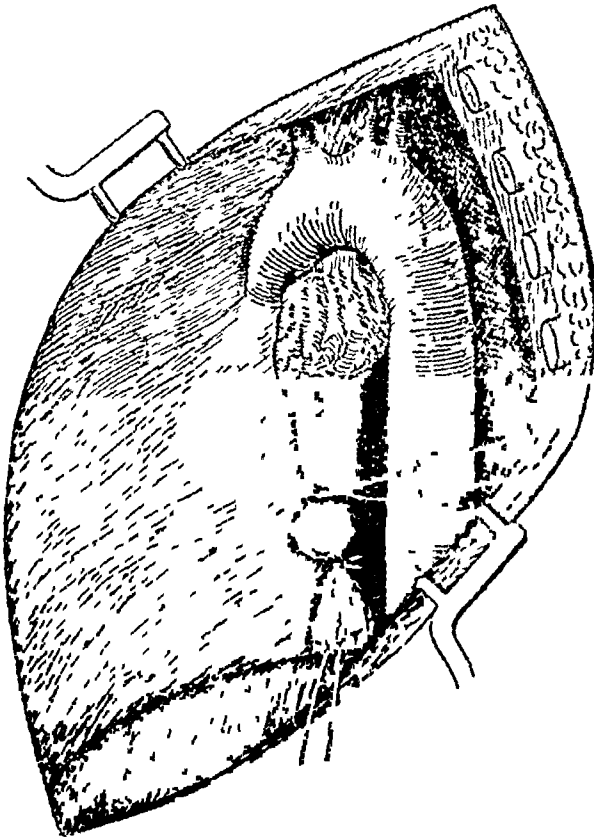


FIG. 9.—The œsophagus is doubly ligated before being cut. About 2 cm. below the lower ligation a purse string suture is laid for subsequent invagination of the lower stump.

ligature is applied a sufficient distance below the first to enable one to cut the œsophagus between them without danger of the ligatures slipping off (Fig. 9). As the lower one of these ligatures is afterward to be invaginated into the lumen of the œsophagus, it is advisable to reduce the thickness of the end of the stump to a minimum to facilitate invagination. The site of the lower ligation is therefore thoroughly crushed before being tied. The best crushing instrument I know for the

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purpose is Payr's duodenum crusher (Fig 10) Furthermore, a lighter ligature than the one for the upper ligation is selected Before dividing the œsophagus, a purse-string silk suture is inserted 1 or 2 cm below the lower ligation If the site of the carcinoma is so low that there is not sufficient room to insert the invagination sutures beneath the site selected for ablation of the œsophagus, the stomach must be brought up into the thoracic cavity far enough to afford the necessary space for

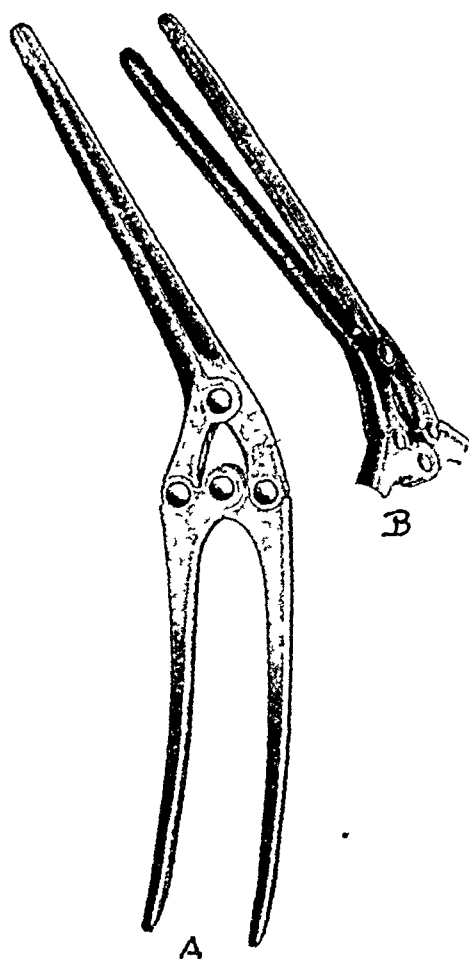


FIG 10 —Payr's clamp A, closed B jaws open

putting in the sutures This is done by splitting the diaphragm and peritoneum in front of the hiatus, with careful ligation of vessels, sufficiently far forward to permit the upward dislodgement of as much stomach as necessary The left gastric artery is divided if it interferes with drawing the stomach upward Without dividing the diaphragm, the œsophagus may be drawn up into the thorax for 1 or 2 cm, after it has been loosened at the hiatus Occasionally, a small portion of the cardia may be drawn up into the thorax in this manner The œsophagus

is now divided between the two ligatures and the mucosa of the upper stump cauterized with a Paquelin cautery or with carbolic acid. If the crushing of the lower stump has been sufficiently extensive, there will be no mucosa in it, if any remain, it is trimmed off or cauterized. The lower stump is now invaginated and secured by the purse-string suture previously introduced, and, if possible, a second purse-string suture is placed to still further invaginate the stump. If the diaphragm had been divided, it is now accurately sutured. The upper stump is pushed through the channel beneath the arch of the aorta, and the ligature at its end is tied to the silk thread which had been introduced into the pleura through the neck incision. The œsophagus, with the tumor

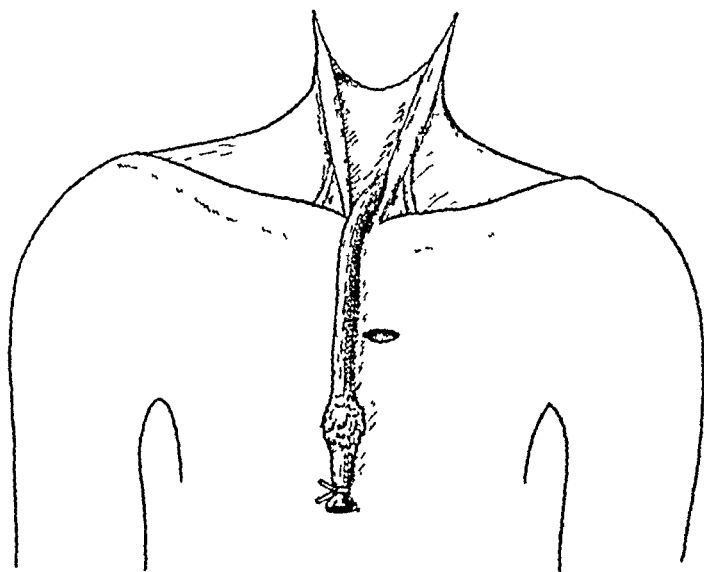


FIG. 11.—Esophagus brought out through an incision in the neck. On the chest a transverse incision is made corresponding to the place where the esophagus is to be amputated. Between these two incisions the skin is subsequently tunnelled for the reception of the esophagus.

attached, is now drawn out through the neck wound (Fig. 11). There it is allowed to remain, for the time being, wrapped in gauze.

We next proceed to close the chest. A few sutures of strong silk are placed to hold the seventh and eighth ribs in apposition. These sutures are carried *around* the two ribs (pericostal sutures, Fig. 12), or they may be carried *through* the ribs after punching holes in them with Friedrich's punch. No attempt is made to reunite the ends of the cut ribs; they fall in proper alignment of themselves. The muscles are united in layers by catgut sutures. Before making the suture air-tight, the lung is thoroughly inflated to bring its surface in contact with the parietal pleura. There exists in the minds of many surgeons a great fear of

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some air be allowed to remain in the pleural cavity, as evinced by numerous articles that have been written to set forth the difficulty of completely doing away with the pneumothorax. I am convinced that a small amount of air left in the pleural cavity is entirely harmless. The experience with the production of artificial pneumothorax as a method of treating tuberculosis of the lungs has further shown that air introduced into the pleural cavity is very rapidly absorbed. Nevertheless, the effort should be made to expand the lung to its full extent. The suture of the skin completes the closure of the thoracic wound.

We now again turn our attention to the œsophagus, which, with the tumor at its end, hangs out from the neck. We hold it down over the front of the chest, estimate where it is to be amputated, and make a transverse incision through the skin at the site corresponding to this point (Fig 11). The skin between the neck wound and the new incision on the chest is then undermined with a blunt instrument, and the œsophagus, still unopened, with the tumor attached, is drawn through

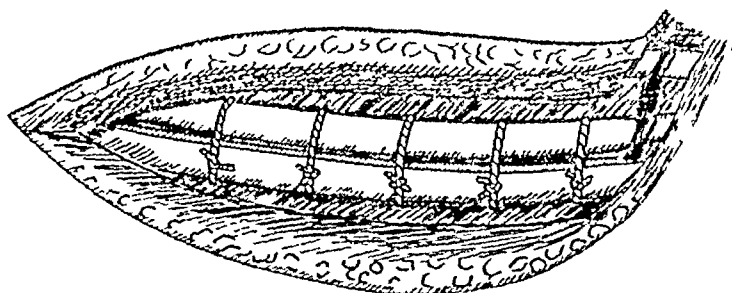


FIG 12 —Pericostal suture holding seventh and eighth ribs together

this tunnel and out through the new wound. The incision in the neck is closed, the tumor amputated, and the free end of the œsophagus sutured to the skin by a few interrupted stitches.

The most comfortable position for the patient after operation is partly on the right side and partly on the back. Morphine is given for a few days, and stimulants are administered according to the usual indications. Camphor, caffeine, digitalin, and strophanthus are given for acute cardiac weakness. Nourishment is given through the gastrostomy tube. After the free end of the œsophagus has thoroughly healed to the skin, the upper end of the gastrostomy tube is inserted into it, when the patient wishes to take nourishment (Fig 13). During the act of swallowing a little pressure is brought to bear on the skin at one side of the tube to prevent leakage. A fairly large tube is selected. The swallowed food passes from the œsophagus into the rubber tube and thence into the stomach.

The patient on whom I operated according to this method 20½ months ago is able to eat practically all kinds of food. She is wearing a tube, the upper or œsophageal end of which is bevelled so as to adapt itself better to the end of the œsophagus. The bevelled end is also thickened and rounded off smooth (Fig 14). By virtue of the thickening of the rim it retains itself after introduction, and its smoothness guarantees against irritation of the œsophagus. The stomach end of the tube is bevelled in the ordinary way, and, a short distance above the end, the tube is closely hugged by a round rubber ring which indicates the distance to which the tube is inserted.

Besides this one case I have attempted the operation in two cases both of which were unsuitable for resection. One was a woman who, in spite of her gastrostomy feeding, continued to lose weight. She died suddenly, five days after the operation, apparently from cardiac failure. The other was an alcoholic male with advanced cirrhosis of the liver, nephritis, and myocarditis. He died in the course of the night following the operation. In neither of the two cases was an autopsy permitted.

As the œsophagus lies between the two pleuræ, the question naturally arises whether it is better to attack it from the right side or from the left. An argument in favor of the right side would be that here the aorta is not in the way, also that the œsophagus stands out more prominently than on the left side, owing to the fact that the right pleura partly envelops the œsophagus, being tucked in to some extent behind it. The only obstacle is the vena azygos, and that may be divided. However, while it is true that the upper part of the œsophagus is more easily accessible on the right side than on the left, in the lower portion the liver forms a serious hindrance. This organ presses the diaphragm high up into the thorax, leaving but a very narrow space behind its dome for operating on the lower part of the œsophagus, thus greatly interfering with access to the part, possibly rendering operation entirely infeasible. One might conclude, therefore, that, if there were definite proof that the operation would be limited to the upper two-thirds of the œsophagus, the right side may be elected, but if we are uncertain how far down the affection extends, which is more frequently the case, the attack will be from the left side. Another possible objection to operating from the right side, which, however, I have not yet been able to test, may lie in the fact that the right lung is the larger of the two and that its collapse during the operation may perhaps interfere with vital functions to a greater degree than would happen in case of collapse of the left lung.

Operation for Carcinoma of the Abdominal Portion of the Œsoph-

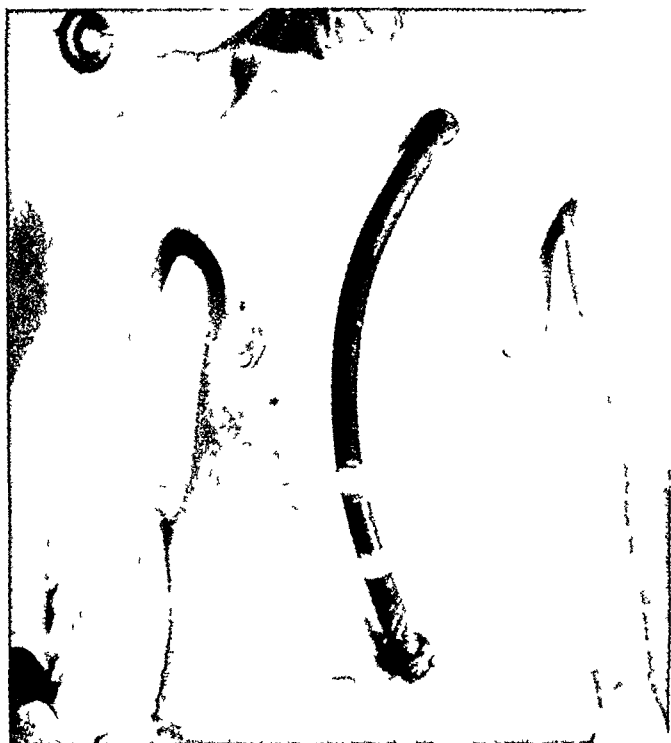


FIG 13 —Tube connecting lower end of œsophagus with gastrostomy opening The two light stripes on the rubber tube in this and the following figure are remnants of adhesive plaster which was removed before taking the picture

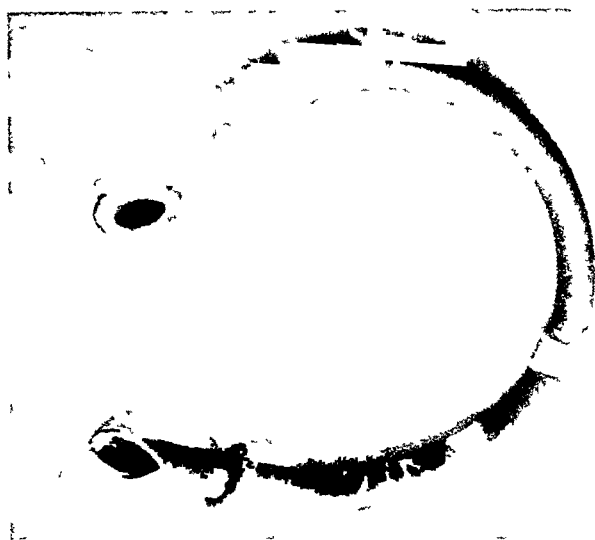


FIG 14 —Note the bevelled and thickened upper end of the tube and the rubber ring near the lower end

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agus—In carcinoma of the abdominal portion, which usually also involves the cardiac end of the stomach, I recommend operating in three stages, according to a method which I worked out early in 1913 and first performed on the cadaver in April of the same year, with the assistance of Dr Joseph King. These stages are as follows (1) Gastrostomy (2) Thoracotomy, as described above for carcinoma of the thoracic œsophagus. After division of the œsophagus in its lower part, the upper end is brought out at the neck, as described above, and the lower end is invaginated and placed beneath the diaphragm which is closed by suture (3) An abdominal operation to resect the tumor. An incision is made from the ensiform cartilage along the entire length of the left costal arch, thoroughly dividing the abdominal muscles, particularly at the posterior end, so that the costal arch can be well raised. At the œsophageal hiatus of the diaphragm the peritoneum is divided and the stump of the œsophagus brought down. Then the tumor is resected, with the removal of as much of the stomach as is indicated.

A similar plan of operating could also be followed in cases of carcinoma of the thoracic œsophagus at its lowermost portion, where there is not sufficient room to amputate below the tumor.

Other Methods—Zaaijer, already referred to, was the first to operate successfully in a case of carcinoma of the cardia by the transpleural route. In his case, although an invasion of the lower end of the œsophagus is reported, we are informed that the œsophageal bougie met the obstruction at 45 cm from the incisors—an exceptionally long distance. He operated in three stages (1) Gastrostomy at the pyloric portion, Kader's method (2) Extensive rib resection in order to cause collapse of the thorax and thereby bring the lower portion of the œsophagus and cardia nearer the surface of the body, thus reducing considerably the depth at which the main operation is performed. The lowest 7 ribs of the left side are resected in almost their entire length through two parallel incisions about 25 cm long, the superficial musculature is extirpated; the skin sutured. Zaaijer's patient had considerable dyspnoea the first 2 days following operation. Zaaijer believes this due to mediastinal fluttering caused by the great mobility of the thorax, and, in view of this experience, recommends leaving the twelfth rib intact, or at least not removing it at the same sitting (3) Resection of the tumor by laparo-thoracotomy. The skin incision is made in the left hypochondrium about in the mammillary line, from the upper end it is carried in a curvilinear direction backward to the posterior axillary line, thence upward a little higher than the angle of the scapula. Peritoneum and pleura are opened. The diaphragm is divided from below upward.

to the hiatus. Oesophagus and stomach are made movable, the lesser omentum is divided. The stomach is then divided between two clamps and the lower end sutured. The oesophagus is drawn to the skin in the neighborhood of the posterior axillary line and sutured there. The end of the oesophagus and the gastric fistula are connected by a rubber tube. According to Zaaier, this method of operation is limited to carcinoma of the cardia and of the very lowest portion of the oesophagus.

A very interesting method of operating in cases of carcinoma of the cardia has been proposed by Ach. The operation is done from the abdomen and from the neck without opening the thorax. At the anterior

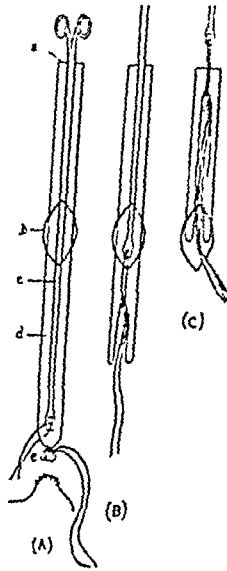


FIG. 15.—Diagram of Ach's method of extracting the normal oesophagus by evagination, without opening the thorax. (A) *a* mouth, *b* incision in neck, *c* thin steel rod introduced into *d*, oesophagus, *e* lower end of oesophagus, tied and cut off from stomach through an abdominal incision, the ends of the ligature being left long. (B) Rod drawn up and invagination begun. (C) Oesophagus is again evaginated through neck incision by drawing on ends of ligature with which its lower end was tied. The steel rod which is now outside the mouth is released by cutting the string that passes through its loop.

border of the sternocleidomastoid muscle the oesophagus is exposed, and the wound is temporarily tamponed. Through an abdominal incision the peritoneal covering of the oesophagus at the hiatus is divided, and, with the finger introduced into the hiatus, the oesophagus is loosened as far as possible. A portion of the oesophagus is now drawn down into the abdomen. It is tied off with strong linen thread, about 2 cm. above the tumor, and cut below the ligature. The two ends of the ligature are left about $\frac{1}{2}$ m. long. A thin, flexible steel rod, 60 cm. in length, which terminates at its lower end in a little ring, is introduced through the mouth down to the bottom of the oesophagus. A needle armed with strong linen thread now transfixes the lower end of the oesophagus and

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the ring, the thread is drawn through, and its ends are knotted together at a distance of about 12 cm below the Œsophagus. The steel rod is now drawn up again, the thread held in its ring-shaped extremity follows and invaginates the Œsophagus into itself. According to Ach, it can be drawn up without encountering much resistance. As soon as the lowest part of the cervical Œsophagus is seen through the neck incision to become invaginated, the long thread with which the lower end of the Œsophagus was tied is pulled out through the wound in the neck. By traction on this thread the Œsophagus is again evaginated and drawn out through the neck after the staff has been released by cutting the thread that passes through its ring, in front of the patient's mouth. The procedure is shown diagrammatically in Fig 15. The cardia is then resected and a gastrostomy done.

This, then, is a brief outline of what can be done surgically for carcinoma of the Œsophagus. Though in actual results but little has been accomplished, it is a source of satisfaction to know that a beginning has been made. Whether this beginning will be followed by a series of successes depends mainly upon our ability to operate while the disease is strictly localized and the patient still in fairly good condition. It would be a mistake, at the present stage of the development of this chapter, to operate on patients who are unfavorable subjects. By such attempts, which are bound to result in failure, the operation would only be discredited and we could not hope to get patients to submit to operation while they are still in an early stage of the disease.

GASTRIC AND DUODENAL ULCER

A REVIEW OF 120 CASES OPERATED UPON AT THE ROOSEVELT HOSPITAL BY THE SURGICAL STAFF DURING THE PAST FIVE YEARS

BY CHARLES H. PECK, M.D.
OF NEW YORK

ATTENDING SURGEON TO THE ROOSEVELT HOSPITAL

THIS report consists of a review of 120 cases of non-malignant ulcer of the stomach and duodenum which have been operated upon by members of the surgical staff at the Roosevelt Hospital between January 1, 1910 and January 1, 1915. Of the 120 cases, 73.3 per cent were duodenal, and 26.7 per cent gastric. Of the 88 duodenal ulcers 71 were of the chronic indurated type and 17 were acute perforations. Of the 30 gastric ulcers, 17 were chronic non-perforative, and 13 acute perforations—an unusually high percentage of acute perforations for this latter group. Considering the group as a whole, 78.3 per cent were males, 21.7 per cent females. In the duodenal group 83 per cent were males, and in the gastric group 70 per cent.

It was of interest to note that all of the 17 acute perforated duodenal ulcers occurred in males, the ages ranging from twenty-three to fifty-two. Of the 13 acute perforated gastric ulcers, 9 were males, and 4 females, the ages ranging from twenty-three to forty-nine.

Taking all cases together, the number occurring in each decade from twenty years to fifty was almost equal, from fifty to sixty years somewhat less, and between sixty and seventy years fewer,—but still a goodly number.

Taking up the study of the cases by groups, there were 71 cases of chronic duodenal ulcer, in all of which the condition was verified by operation, and posterior gastro-enterostomy was performed. In 44 the site of the ulcer was anterior, generally close to the pylorus, 19 were posterior, 2 multiple, 1 in the second portion of the duodenum, and in 5 the exact site was not stated.

In addition to the gastro-enterostomy, when possible, especially in the ulcers situated on the anterior surface of the duodenum, the area was infolded by Lembert sutures, thus causing some degree of pyloric occlusion. In only one of the group was typical exclusion performed, this was a case which had bled repeatedly both before and after gastro-enterostomy—the von Eiselsberg unilateral exclusion being performed in March, 1911, about a year after the gastro-enterostomy. In January,

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1914, the patient was still having pain and occasional intestinal hemorrhages

Appendectomy was done in 25 of these 71 cases, cholecystostomy for gall-stones in two cases

In studying the symptoms presented in this group it was found that hæmatemesis occurred in 13 cases, in 10 of which intestinal hemorrhage was also present. Intestinal hemorrhage occurred in 11 additional cases—21 in all. In 30 cases it was definitely stated that no hemorrhage occurred, and in the remainder the history failed to state. Hemorrhage occurred, therefore, in about 43 per cent of the observations, our experience coinciding with that of so many others in showing that hemorrhage occurs in less than 50 per cent of the cases.

Pain of a characteristic type, occurring from two to four hours after meals, relieved by food or alkalines, was noted in 24 cases—less than 50 per cent of the cases in which the character of the pain was recorded. In 26 additional cases, pain, while present, was irregular in occurrence, bore no relation to the taking of food, or occurred within a short time after meals, *i e*, in more than 50 per cent of the records, the pain was atypical rather than of the classic type attributed to chronic duodenal ulcer. Pain of some sort, however, was a constant symptom.

Vomiting at some time during the illness occurred in about half of the cases, but relatively few had persistent or frequent vomiting.

Records of gastric analysis in 40 of the cases showed free hydrochloric acid below 40 in 20 cases (50 per cent), between 40 and 60 in 13 cases, and above 60 in 7 cases. The total acidity corresponded fairly well to the percentage of free acid, six of the cases showing a total acidity above 90. In no case was absence of free HCl noted.

Observation of the red cell count was made on 30 of the cases, with the following results. Above 6,000,000, 4 cases, between 5,000,000 and 6,000,000, 8 cases, a total of 12 cases, or 40 per cent, with some degree of polycythæmia. Eighteen cases (60 per cent) had a count of 5,000,000, or less. In estimating the value of polycythæmia as a diagnostic sign in chronic duodenal ulcer, one must of course allow for secondary anæmia due to repeated hemorrhage, but even considering this, our observation on this series would seem to indicate that this sign is of only limited diagnostic value.

Of the 71 cases 65 recovered and 6 died—a mortality of 8.4 per cent. This relatively high mortality is partly due to the fact that several of the cases were very poor operative risks on account of age, extreme cachexia and alcoholism. Only three of the deaths seemed

the direct result of the gastro-enterostomy *per se*, and one of these was a man of advanced years who was much depleted by repeated intestinal hemorrhages. The causes of death in detail were as follows:

CASE I (No B3332) —Embolic pneumonia and pulmonary abscess, with death on the nineteenth day after operation in a man sixty-four years of age

CASE II (B4135) —Acute gastric dilatation, persistent vomiting, died on the sixth day after operation following a secondary operation performed on the fifth day

CASE III (B4644) —Post-operative shock and exhaustion eight hours after operation. Supposed ulcer in second portion of duodenum, diagnosis never fully proven. Marked cachexia, which was perhaps due to some undiscovered cause. No autopsy

CASE IV (A6001) —Persistent vomiting, entero-enterostomy on the fourth day, death on the fifth day after primary operation

CASE V (A3077) —An alcoholic man thirty-eight years of age, bronchopneumonia, death on the fourth day

CASE VI (B3380) —A very anæmic, cachectic man, forty-four years of age, with large, multiple ulcers of the duodenum and a complicating megacolon, operated upon under diagnosis of malignant disease of colon, massive induration about ulcers thought to be neoplasm, but not proven at autopsy. Wound broke open on seventh day, death on ninth day

In estimating the late results, we have had some difficulty in following hospital cases satisfactorily, and our efforts in this group have not covered a sufficient period of time to be complete. Definite late reports have been obtained in 36 cases, in all but 4 of which the late results have been most satisfactory. One of these, already referred to, still has pain and hemorrhage,—the case in which secondary pyloric exclusion was performed, another made a slow convalescence, but finally a satisfactory one, after secondary entero-anastomosis for recurring vomiting. Two others are much improved, but still have pain and indigestion at times. Two of the 32 cases were traced a few months only, when one returned home to Italy and one to Russia.

Many of these cases have been followed from two to four years and their restoration to comfort and health, often after years of suffering from the effects of the ulcer, has been most striking and satisfactory. Efforts are being made to follow others of the group, but many are hopelessly lost through change of address, in the poorer sections of the city. For the past two years an improved system of following up cases after discharge from the hospital has enabled us to keep better track of the late results.

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Chronic Gastric Ulcer—The 19 cases of chronic gastric ulcer in the series, gave less satisfactory results than the duodenal. Gastro-enterostomy was performed in 12 of the cases, partial gastrectomy in 3, excision of the ulcer without gastro-enterostomy in 2, cautery puncture with gastro-enterostomy in 1, and exploratory coeliotomy in 1 case. There were 3 deaths in the series, and a fourth case returned to the hospital shortly after discharge with pneumonia, from which he died.

Twelve of the ulcers were on the lesser curvature at some distance from the pylorus, 2 were on the posterior wall, 4 were pyloric, and in 1 the position was not stated.

Hæmatemesis had occurred in 10 cases, was absent in 7, and not mentioned in 3.

Pain was a constant symptom, generally made worse by the ingestion of food, relieved by vomiting. It varied in intensity, but there were seldom free intervals lasting days or weeks, as is so often the case in duodenal ulcer. Pain was generally more constant and severe than the pain of duodenal ulcer.

Gastric analysis in 12 of the cases showed free HCl 40 or below, in 8 cases, 60 in 2 cases, and absent in 2 cases.

These findings again emphasize the fact that the results of gastric analysis are of only limited diagnostic value.

Our series of gastric ulcers is quite too small to establish rules of management for the different types, but, in general, I believe that ulcers near the pylorus, especially those associated with a good deal of induration, and which it is difficult to differentiate, clinically, from carcinoma, should be excised—*i e*, pylorotomy or partial gastrectomy should be performed. When situated on the lesser curvature near its middle, or at the cardiac end, one may consider (1) Excision (V-resection with suture) with or without gastro-enterostomy, (2) cautery puncture of the ulcer, as suggested by Balfour, with closure of the hole by suture, with or without gastro-enterostomy, (3) gastro-enterostomy alone, without direct attack on the ulcer.

In our series 2 cases were treated by V-excision without gastro-enterostomy, one has made a perfect recovery, is well two years after the operation, and has gained twenty pounds, the other has had persistent pain and indigestion, was readmitted three years after the primary operation, but refused the secondary operation which was advised.

One recent case of penetrating indurated ulcer high on the lesser curvature was treated by cautery puncture (Balfour) with gastro-enterostomy. The cautery point was plunged through the centre of the

ulcer, and by burning around the edges of the opening the entire ulcer was practically ablated, the opening left in the gastric wall was closed by suture, reinforced by a tier of Lembert sutures, and, finally, by the fatty tissue from the lesser omentum. The procedure is simple, quick, and I was much impressed with it as a means of dealing with high lesser curvature ulcers where V-excision is so difficult. Even if one does not succeed in cauterizing out all of the ulcer, the reparative process thus excited should greatly hasten its healing. The patient was quite free from symptoms when last seen.

I believe it is wise to do gastro-enterostomy in every case whether cautery puncture, V-excision, or any direct treatment of the ulcer is used, for it is quite possible that the chemical change in the gastric juice and contents, as pointed out by Patterson, has at least some influence favoring healing of the ulcer. One case of ulcer, quite close to the cardia, in which exploratory cœliotomy only was done one year ago, has continued to have pain and indigestion, and I have regretted that gastro-enterostomy was not done in this case. I was not at the time familiar with the method of cautery puncture, and was under the impression that gastro-enterostomy was practically useless in ulcers near the cardia.

Of the 3 cases treated by partial gastrectomy, 2 recovered, and 1 died of shock—a difficult case, with the ulcer situated far up on the lesser curvature. Both of the cases which recovered are quite well and free from gastric symptoms two years six months, and two years nine months after operation, respectively.

Of the 12 cases in which gastro-enterostomy alone was performed, there were 3 deaths: 1 from persistent vomiting which secondary operation failed to relieve, 1 from pneumonia with pulmonary embolus on the eighth day. The third fatal case left the hospital well from his operation, but returned in a few days ill from pneumonia, from which he died.

Of the 9 cases which recovered, 3 are known to be free from gastric symptoms at twenty-one months, fourteen months, and four months, after operation. Two continue to have pain and indigestion at twelve months and eighteen months after operation. Four of the earlier cases we have been unable to trace. The number of cases in this group is too small and the end results too imperfectly traced to draw conclusions of much value, but it is quite evident that the results of gastro-enterostomy for gastric ulcer, without excision of the ulcer, are much less satisfactory than in duodenal ulcer. We have had no late development of carcinoma in a gastric ulcer as far as we know, though

it is quite possible that it may have occurred in some of the untraced cases. It is also possible that it may have been present in the case which returned (B1479), two years and nine months after V-excision, with persistent symptoms and marked cachexia, and who refused to remain in the hospital for further investigation or operation.

Perforated Duodenal Ulcer—Of the 17 cases of acute perforated duodenal ulcer, 2 died before leaving the hospital, 1 of pneumonia on the seventeenth day after operation, and 1 after a secondary operation for subphrenic abscess twenty-two days after primary operation. Two others died shortly after leaving the hospital, 1 of pulmonary tuberculosis lighted up by the illness and operation, and 1 a few days after discharge, of hemorrhage from an ulcer situated on the inferior wall against the head of the pancreas. In this latter case, the primary operation showed a large, localized abscess in the upper abdomen containing gas, the site of the perforation was not located, and any attempt at closure was impossible.

No case died of extension of the peritonitis. In 4 of the cases simple closure of the ulcer without gastro-enterostomy was employed, with 1 death, in 1, drainage of a large localized abscess, without suture (the fatal case just cited). In 12, posterior gastro-enterostomy was done in addition to closure of the perforation, with 11 recoveries and 1 death (pneumonia on the seventeenth day). While the series is too short to be conclusive, gastro-enterostomy does not seem to have had an unfavorable influence on the mortality.

As to the time which had elapsed between symptoms of perforation and operation—of the fatal cases 1 had had symptoms for three days, with moderate leakage (death from pneumonia), 1 for five hours (death from subphrenic abscess). Of the 15 cases which recovered from the operation 9 were operated upon within twelve hours, 4 in twelve, twenty-seven, thirty-one and forty-eight hours, respectively, and in 2 the history indicated perforation several days before, with partial sealing by adhesions and fresh leakage a few hours before operation.

Of the 17 cases, 10 were closed without drainage, and 7 were drained. One of the fatal cases was drained, the other was not.

One can conclude from this study that cases of acute perforated duodenal ulcer, if operated upon promptly, should rarely die of peritonitis, that drainage can safely be omitted in the average case, but should be used if the closure of the perforation is insecure, or if a walled-off abscess has formed, making further pus formation probable,

that gastro-enterostomy should not increase the mortality, if used in properly selected cases

Opinions are divided as to the wisdom of performing gastro-enterostomy in the presence of acute perforation, but it seems rational to suppose that a permanent cure of the ulcer would be aided thereby, though undoubtedly many undergo spontaneous healing after perforation and simple suture, and remain well

The extent of the peritonitis present at the time of operation varied from a moderate amount of fluid in the upper abdomen, to a generalized process involving both flanks of the pelvis. Drainage of the pelvis or flanks was resorted to in 1 case only

Of 6 cases which we have been able to trace, 4, in all of which gastro-enterostomy was performed, are perfectly well at four years, three years, two and one-quarter years, and two years, respectively. One remained well and free from gastric symptoms for over three years, but for the last year has again complained of occasional pain and indigestion. One case, operated upon two years ago without gastro-enterostomy, suffers from pain and indigestion, constantly. Seven cases we have been unable to trace as yet for late results, though all were known to be well for a considerable time after leaving the hospital

Perforated Gastric Ulcer—Of the 13 cases of perforated gastric ulcer, 7 recovered and 6 died. The 6 fatal cases all died of peritonitis: 1 having pneumonia, 1 subphrenic abscess and pleurisy, and 1 delirium tremens, in addition to the peritonitis. Four of the 6 were late operations from one to five days after perforation, with peritonitis already well-developed. The other 2 were operated upon twelve and thirteen hours, respectively, after perforation. Both had extensive leakage and peritonitis. Gastro-enterostomy was not performed in any of the fatal cases, but was done in addition to closure of the ulcer by suture in 5 of the 7 cases which recovered. In 5 of the 13 cases the perforation was prepyloric, in 5 on the lesser curvature at some distance from the pylorus, in 3 (two of which were advanced cases of peritonitis, and fatal) the site of the perforation was not accurately located, though it was believed to be gastric

Of the 7 cases which recovered, 3 were operated upon about six hours, and 1, twelve hours after perforation, in 2 there were well-localized epigastric abscesses, and in 1, the perforation was partly sealed by adhesions

For the prepyloric group of perforations, indications for gastro-enterostomy at the time of the primary operation would seem to be the

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same as in duodenal ulcer; *i e*, when the patient is in good condition and future pyloric obstruction probable, gastro-enterostomy may be performed

In perforation on the lesser curvature or anterior wall, the need of it is less evident, and simple closure by suture is usually sufficient. It is better to leave the gastro-enterostomy for a future time than to do it under conditions which greatly increase the immediate operative risk.

It is frequently stated that symptoms of acute perforation often come out of a clear sky without previous symptoms of gastric trouble. Of the 17 cases of duodenal perforation, all but 2 gave a history of previous indigestion, though in 4 of these the history was a short one of from one to two weeks. In the gastric group practically all of the cases had had previous ulcer symptoms.

Radiographic findings are becoming of more and more aid in the diagnosis of chronic ulcers, both gastric and duodenal. In gastric ulcers, especially, positive evidence is often obtained in cases where other signs and symptoms are very doubtful. Our records are too incomplete to attempt to tabulate the findings in this series, but it is enough to say that all suspected cases are now examined in this way as a routine, and not only in many cases is the diagnosis definitely established, but negative explorations are less frequently done than was the case before this valuable aid in diagnosis was available.

In conclusion, I wish to thank my colleagues on the Surgical Staff of the Hospital for permission to include their cases in this report.

ON RETROPERITONEAL PERFORATION OF DUODENAL ULCER

BY GUSTAF PETREN, M D

DOCENT OF SURGERY AT THE UNIVERSITY OF LUND (SWEDEN)

THE majority (90-95 per cent) of duodenal ulcers are situated in the first part of the duodenum, *pars horizontalis superior*, and most frequently near the pylorus. If such an ulcer perforates, the usual result is peritonitis. A small number of duodenal ulcers are situated further down in the duodenum, in its *pars verticalis* or (even more rarely) in its *pars horizontalis inferior*. If an ulcer in these parts occurs on the back wall, not covered by the peritoneum, and perforates, the perforation leads to inflammation in the retroperitoneal tissue. The retroperitoneal phlegmon or abscess as a complication to duodenal ulcer is rare, it is true, and it has therefore been extremely scantily treated both in the text-books and in monographs, but, nevertheless, it deserves, in my opinion, to receive more attention than has so far been accorded to it. As I have had the opportunity to operate one case of retroperitoneal abscess (Case I), where, it is true, the source was not placed beyond doubt by post-mortem examination, because the patient recovered, but which was unquestionably a perforated duodenal ulcer, it seems to me justifiable to communicate the case, and expedient in connection therewith to adduce cases bearing on the matter from the literature of the subject, in order to direct attention to this sometimes neglected complication of duodenal ulcer and to make a contribution to the common stock of knowledge on the subject.

CASE I—B J B, male, sixty-three years old, tended at Trallegård Hospital, February 14 to March 13, 1912

Anamnesis—Ever since the age of fifteen to twenty the patient had had "pains in the belly" in the form of periodically recurring stomachic troubles, sometimes felt free of symptoms for a couple of months at a time, but afterwards for some days or weeks had "heart-burn," eructations, felt discomfort in the pit of the stomach after fat food or coffee, and sometimes had vomitings, the pain had usually come one to two hours after a meal, vomitings often not till two or three hours after, and he had mostly had to follow a more or less strict diet. At the age of forty-five he had, during 4-5 days, repeated vomitings of blood, and after that tar-colored evacuations for a day or two more. He was on that occasion very poorly and kept his bed for three or four weeks. The patient did

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not begin to take spirituous liquors till about the age of forty-five, but after the age of forty-five to fifty he took them in greater quantity and during the last few years, at least periodically, in excess. During the last six months the patient had had serious stomachic troubles and often vomitings, and during the last few months he had sometimes even been confined to his bed. About three weeks ago he became worse and had increasing pain in the right side of the abdomen and as early as two weeks ago he was so bad that he could scarcely stand (at that time he declined to take the hospital nursing which was then proposed for him). He had stayed in bed at home during these two weeks with fever (generally between 100° and 102°), without appetite, occasional vomitings, difficult evacuation, severe pains in the right side of the abdomen, shiverings once or twice during the last week and a general state of weakness. No urinary troubles: the urine had on repeated examinations contained albumen. The doctor in charge of the case could discover no symptoms of appendicitis, nor of peritonitis, or even of peritoneal irritation, but during the last part of the fortnight he was able to feel, at about the site of the right kidney, a painful resistance, which increased downward and became more and more distinct. The patient entered the Tralleborg Hospital on February 14, 1912.

Condition February 14, 1912. Considerably affected, feels weak and poorly. Though still fairly fleshy, yet looks in low condition. Temperature 102° , pulse 110-120. Urine contains albumen to a small amount, the sediment only a few leucocytes. No appetite at all, occasional vomitings, obstipation and difficult passing of gas. The abdomen is not dilated: its left-hand and upper portion, and also the medial part of the right side of the abdomen, are soft and callous. At a considerable distance laterally on the right side of the abdomen a resistance can be palpated, that evidently lies deep, is indistinctly limited upward and laterally, but is distinctly limited medially and downward, the size of two fists, and tender to deep palpation: this extends from the site of the lower half of the right kidney downward to the right fossa iliaca, with its lower pole about two or three finger-breadths below spina iliaca ant. sup.

Operation (February 14, 1912) (by the present writer) —Under a local anæsthetic an extraperitoneal incision, 8-9 cm long, is made above spina iliaca ant. sup., in a downward and medial direction, through the musculature of the abdominal wall, and more than a tumblerful of distinctly thick pus is emptied from an abscess cavity, manifestly retroperitoneal, well defined downward and forward. The course of recovery was regular, with a temperature after four days of 100.5° , copious secretion of pus during the first week or two, afterwards a smaller secretion and a

good cure. The patient's general condition improved but slowly during the first two or three weeks he had no appetite, found it difficult to take food, and occasionally vomited. Began to dress and lie on the couch after three weeks and went home on March 13, almost wholly healed and free of albumen in the urine and in rapid convalescence. After his return home the improvement continued steadily during the first six months he put on about 10 kg in weight. According to information received in February, 1914, he has felt pretty well since the operation, though he has now and again had his old stomachic troubles—"heart-burn," belching, discomfort and occasionally vomiting, usually two hours after a meal.

In this case both the stomachic symptoms mentioned in the anamnesis as occurring periodically ever since the years of adolescence in the form of pains, one, two or three hours after meals, and also the appearance eighteen years ago of copious bleeding in form of hæmatemesis and tar-colored evacuations, indicate that the man had suffered from duodenal ulcer, and as late as January, 1912—to judge by the increased and more than usually severe stomachic symptoms during the last preceding months—he certainly had an open and unhealed ulcer. The history of the case further shows that at the end of January, 1912—that is to say, three weeks before he was admitted to the hospital and underwent the operation—he became worse, had pains in the right side of the abdomen, and then kept his bed with his general health clearly affected by fever and later by shiverings, loss of appetite, occasional vomitings, decrease of strength, and was steadily growing worse, while a deep situated tender resistance developed in the neighborhood of the site of the right kidney and gradually spread downward. At the operation the resistance proved to be a retroperitoneal abscess cavity, with well-defined limits downward and forward, in an upward direction, on the other hand, a finger introduced into the cavity could feel no boundary. The abscess was drained and healed without any complications in a few weeks. The question now is, whence comes the retroperitoneal abscess in this case? The first and most obvious possibility is that it may be a circumscribed appendicular abscess. The objections to this view are that during the first week of the illness the patient exhibited no objective symptoms pointing to acute appendicitis, and that from the time he felt ill he never had any symptoms whatever of peritoneal irritation, although, if it had been a case of acute appendicitis, this would have been the first attack. Moreover, the resistance in the right lumbar region was palpated, on its first appearance, high up in the site of the right kidney, and developed downward, and as regards

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shape the resistance was evidently well defined downward and forward, and in the palpatory investigation behaved most like a tuberculous abscess which was in process of sinking into the fossa iliaca. On the strength of the anamnesis and what was ascertained by palpation and at the operation, acute appendicitis would seem, with a very high degree of probability, to be excluded as a possible cause of this suppuration. My first tentative diagnosis at the examination of the patient in his home was paranephritic abscess with the right kidney as the probable starting-point. He had at that time albumen in the urine. But the patient had never before, nor during the two years since the operation, had any symptoms pointing to any of the kidney diseases that are usually complicated by paranephritic abscesses, in fact, he has never had any symptoms whatever from the urinary organs. Moreover, while further examination showed indeed that the urine contained a small amount of albumen, it also proved to have no other pathological constituents whatever, and even the albumen disappeared entirely one or two weeks after the operation under which circumstances the most obvious explanation is that the albuminous urine was of a usually transitory character, connected with his septic general condition. Neither in the anamnesis nor in the status of the patient just before the operation, nor in the after-history of the case, is there any support for the supposition that the retroperitoneal abscess came from the right kidney. Neither is there the slightest reason to believe that the pancreas, the liver or the bile-ducts were in this case the starting-point of the suppuration, such cases have recently been described by Sprengel¹ and others. Almost the only possible starting-point that remains, therefore, is the duodenum. If one puts together such facts, as that the patient undoubtedly had duodenal ulcer and, during the last part of the time, aggravated ulcer-symptoms which, as experience teaches us, is often the case during the time immediately preceding a perforation—it seems to me not only highly probable, but even tolerably certain, that the retroperitoneal abscess in this case was due to perforation of an ulcer in the back wall of the duodenum. In further support of this diagnosis may be adduced the great measure of agreement (as regards symptoms and course of development) between the case in question and Case V below, previously published by the present writer—where the diagnosis, “perforated duodenal ulcer,” was confirmed by section.

Acute retroperitoneal perforation of a duodenal ulcer, with the resultant extensive suppuration in the retroperitoneal tissue, is undoubt-

¹ Sprengel. Klinische Beiträge zu den diffusen entzündlichen Erkrankungen des Retroperitoneums. Archiv f. klin. Chir., bd. 100, s. 382.

edly a rare complication of duodenal ulcer. In the literature of the subject, I have found no more than five certain cases that have been fairly fully described,² all these cases—the history of which is given below—have been such as have come to section, that is, the diagnoses have been diagnoses confirmed by autopsy. In the literature accessible to me I have not come across a single case of this kind that has ended in recovery. This, in my belief, is not due to the fact that such cases have not occurred, but to the fact that they have not been diagnosed or at least have been regarded as so obscure in diagnosis that they have not been published. Every surgeon who has had any considerable number of abdominal cases certainly knows some rare cases resembling that just described—acute retroperitoneal abscesses, of obscure origin, on the right-hand side—which after operation have resulted in restoration to health. In a number of these cases it is my firm belief that the source of infection is a duodenal ulcer. I am, therefore, also convinced that retroperitoneal phlegmon or abscess is neither such an extremely rare form of duodenal ulcer complication nor, in respect of prognosis, so hopeless as the material collected here would lead one to surmise.

The duodenal ulcers which, on perforation, give rise to retroperitoneal suppurations are most frequently on the back wall of the pars verticalis duodeni, but they may also be situated in the pars horizontalis inferior, as, for instance, in a case observed by Warfvinge and Wallis,³ where the somewhat subacute perforation that occurred led both to the appearance of a small and limited retroperitoneal abscess and also to a direct breaking into the vena mesenterica superior with consequent thrombus in the vena porta and suppurative hepatitis.

Acute retroperitoneal perforation leads to an inflammatory process in the retroperitoneal tissue which in different cases may behave differently and pass to different quarters.⁴ Thus, as in the case described

² This collection, therefore, does not include those cases where the diagnosis is not fully clear, indeed, but where the histories of the sicknesses make it seem more probable that they have from the beginning been cases of intraperitoneal perforation with circumscribed abscess, as in the majority of cases of exterior duodenal fistula. Such cases have been collected by Collin, *Étude sur l'ulcère simple du duodenum* (These, Paris, 1894, pp. 17–20), Moynihan, *Duodenal Ulcer* (London, 1910, pp. 194–204), Melchior, *Das Ulcus Duodeni* (*Ergebnisse der Chirurgie und Orthopädie*, bd. 2, 1911, s. 247).

³ Wallis. The fall av suppurativ hepatitis (Three Cases of Suppurative Hepatitis) *Hygiea*, bd. 46, 1884, p. 333.

⁴ The spread of infection into the retroperitoneal tissue after subcutaneous retroperitoneal duodenal rupture is described in a work by Schumacher—*Zur Duodenum Chirurgie* (Bruns Beiträge z. klin. Chir., bd. 1, 1911, pp. 194–300).

above and also in Cases V and VI below, the perforation may lead to the appearance of abscess limited on the right side in the kidney region, which advances behind the colon ascendens down to the right-hand fossa iliaca, somewhat in the manner of a sinking abscess. In Case IV an abscess developed in a similar fashion has penetrated still further, even down to the ligamentum Poupart, spontaneously perforated the skin just above the inner part thereof, and given rise to a permanent fistula, through which a gall-colored fluid with remains of food was drawn off—showing it to be a duodenal fistula. In Case VI, too, there arose a duodenal fistula—in this instance after incision into the retroperitoneal abscess. The perforation may further lead to a somewhat diffused phlegmonous process in the retroperitoneum, as in Case III, where it spread retroperitoneally even to the left side and down into the pelvis. The infection may also spread, as in Case II, from the retroperitoneum along the large vessels up through the diaphragm into the mediastinum—in this particular case in the form of a gaseous phlegmon.

Retroperitoneal perforation appears in some cases suddenly with quite violent symptoms (though not so violent as perforation in the abdominal cavity) rapidly recurring and severe pains in the upper or the right part of the abdomen, vomitings, and disturbance in the general condition of the patient. In other cases the perforation makes its appearance with less marked symptoms, and retroperitoneal inflammatory process may develop, at least in the beginning, quite stealthily and even relatively slowly only after a week or two with indefinite local symptoms such as fever, with possible shiverings, heightened pulse, diminution of appetite and strength. In such cases the diagnosis will be clear when the tenderness increases or a palpable resistance appears, for instance, at the site of the right kidney or in the right fossa iliaca. For this reason, too, it was not until three to five weeks after the perforation that the retroperitoneal abscess was incised in Cases I, III and V. And in Case IV the process developed still more slowly, and after spontaneous perforation gave rise to a duodenal fistula, with which the patient lived $5\frac{1}{2}$ months.

As regards treatment, an early incision of the retroperitoneal phlegmon or abscess is, of course, greatly to be desired. In many cases, especially those with only a small perforation-opening on the duodenal wall and definite limits of the suppuration, a good result would appear to be attainable with no intervention beyond retroperitoneal incision with drainage, as, for example, in Case I, Case V also would perhaps have progressed just as favorably, after incision and drainage, if fatal pneumonia had not supervened. Should there arise—spontaneously or after

incision—a duodenal fistula, the best thing would appear to be to begin with waiting and to hope for spontaneous healing, as in the case of stomachic fistula after incision of a circumscribed intraperitoneal perforating abscess or a stercoral fistula after an operation for acute appendicitis. If, on the other hand, a duodenal fistula shows no signs of healing, but allows the contents of the bowels to pass through by any considerable extent, so that the patient's nutrition begins to suffer, as in Case IV, laparotomy should be performed before the patient loses his strength too much, and in such cases, as Berg⁶ proposed more than ten years ago, the procedure which with the least risks affords the best prospect of the fistula's healing and of a favorable result is gastroenterostomy with pyloric exclusion. To complicate the laparotomy by a transperitoneal incision laterally round the edge of the duodenum into the retroperitoneal tissue with a view to the direct suture of the perforation-opening on the bowel—as Telford and Radley recommend and in one case (Case VI) actually did with unfortunate results—would not seem to be advisable as a first measure and only very rarely necessary.

CASE II (FORSTER,⁶ published in 1861) —Male, aged nineteen, powerful individual, previously in good health. Had long suffered from pains and strain in the stomach region one to two hours after a meal. Suddenly showed symptoms of general acute peritonitis, of which he died a few days later. The autopsy showed the abdominal cavity to contain much gas, exudations and contents of the bowels. In the front wall of the duodenum near the pylorus there was a perforated ulcer. Exactly opposite this, on the back wall of the duodenum, there was likewise a perforated ulcer, which led into an abscess-cavity in the retroperitoneal tissue, the abscess continued in the form of a gaseous phlegmon upward along the great vessels as far as the neck, where the skin was discolored and the cuticular tissue emphysematous.

CASE III (PERRY and SHAW⁷) —G. D., male, aged thirty-two. Five weeks before admission he was seized with sudden severe abdominal pain and vomiting three days after which he had an attack of pleurisy on the right side. On admission fever, painful swelling of the abdomen, the abdominal wall was stretched, and there was marked fulness in the flanks, no ascites could be made out. When he had been in the hospital for four days, an incision was made in the right iliac region, and eight ounces of pus evacuated. Ten days later a second abscess was opened above the left groin. Eventually two more incisions were made.

⁶ A. A. Berg, *Einseitige Ausschaltung der Duodenum bei perforirender Geschwurbildung an der hinteren Wand des absteigenden Duodenalastes*. *Zeitschrift für Chirurgie*, 1903, p. 556.

⁷ Cited from Kraus, *Das perforierende Geschwür im Duodenum*. Berlin, 1865, p. 33.

⁸ Perry and Shaw, *On Diseases of the Duodenum*. *Guy's Hospital Reports*, vol. 50, 1894, p. 270 (case 211).

PERFORATION OF DUODENAL ULCER

one in each loin, and from all four openings pus continued to drain until his death, six months after the onset of his illness. At the autopsy, the abdominal viscera were found to be firmly matted together by old adhesions, and there were several collections of pus in the pelvis behind the peritoneum. In the duodenum immediately below the pylorus there was, upon the posterior wall, a thick-edged perforating ulcer half an inch in diameter.

CASE IV (WAGNER⁸) —Male, aged forty-five. In the autumn of 1898 he began to have continual pains under the right costal margin and occasional vomiting. In February, 1900, there could be observed in the right inguinal region a rounded resistance, which, however, later disappeared to such an extent that he could work from April throughout the summer. In October there again appeared at the same spot a similar resistance, which grew and spontaneously perforated the skin on October 17, giving out a copious supply of stinking brownish-red liquid. After this the fistula remained open and secreted a like liquid. On one occasion he had observed that one hour after eating some grapes the seeds came out through the fistula. He entered the hospital at Hanau, February 14, 1901. Status at reception: had become very thin, abdomen soft and insensitive, no fever, nothing abnormal from the urine, no resistance in the right fossa iliaca, close above the inner half of ligamentum Poupart; there was a large fistula opening, the size of a sixpence piece, from which was secreted bile-colored liquid with small food remains. The patient refused the operation proposed, grew weaker, and died of inanition on April 1. The autopsy revealed on the posterior wall of the pars descendens duodeni a round hole of the size of a small lentil, but no other ulcerations in the stomach or duodenum. A flexible sound inserted through the duodenal perforation went through a narrow, fairly straight passage along the lumbar vertebral column retroperitoneally down to the fistula opening.

CASE V (EURÉN⁹) —A A, female, aged twenty-two, inmate of Jonkopings Hospital August 7 to August 16, 1908. Had suffered from pleurisy three years earlier, but had since been well. Three weeks previously the patient began to feel gripes and strains in the stomach, chiefly after a meal, had appetite, obstipation and now and then shiverings. Was admitted to a cottage hospital on August 1 and there kept for a week during this period had an irregular temperature between 100.8° and 103.6°, indefinite local symptoms, but increasing tenderness was observed somewhere above the lower part of the right kidney, during the last few days occasional vomitings, on the last day a distinct resistance in the right side of the abdomen (appendicitis with retroperitoneal abscess?). The patient was moved to Jonkopings Hospital on August 7, on her arrival she had a temperature of 103.8° and a pulse of 120. Condition on August 8: temperature 99.3°, pulse 100. On the right side of the abdomen, below the costal margin, a pretty large tender resistance could be perceived, which on the inflation of the colon was found to lie behind this. Condition on August 11: during these four days there was a gradually increasing temperature reaching 102.4° in this evening, with pulse at 110 (probable diagnosis: paranephritic abscess).

⁸Wagner. Ein Fall von Duodenalgeschwür mit retroperitonealem Durchbruch. *Munch med Wochenschr*, 1901, p 1388.

⁹Petren. Ueber Perforation von Magen- und Duodenalgeschwüren. *Beiträge zur klin. Chir*, bd 72, 1911, p 453 (Case 99).

Operation, August 12 (Dr EURÉN)—Laparotomy incision above the gall-bladder, which is found to be in good condition, the abdominal cavity is free, the resistance is extraperitoneal. Incision is made above the outer part of the ligamentum Poupart, a way is made paraperitoneally to the resistance, the position of which corresponds to the right kidney, a cavity with thick yellowish-green pus is emptied, flushed and drained, the kidney is not palpable. Course of illness temperature for three days about 101° and pulse about 130, on August 15 symptoms of pneumonia on the right side, death took place on the 16th. The autopsy showed that the abscess originated in a perforated duodenal ulcer on the part not covered with peritoneum, and developed retroperitoneally.

CASE VI (TELFORD and RADLEY¹⁰)—L. J., male, aged forty-three, was admitted to the Manchester Royal Infirmary on February 3, 1912. He gave a history of many years of "indigestion," and had been acutely ill for ten days. His illness began with severe pain in the upper half of the abdomen, and was followed by vomiting. The pain and vomiting had continued without remission since the attack. He was a spare man of good facies. His temperature was 100° and pulse 120. There was a large and obviously inflammatory mass in the right iliac fossa, extending for some distance upwards into the loin. The rest of the abdomen was flat and loose. The case was regarded as one of appendicular abscess, and an operation was performed at once. An incision was made over the swelling close to the anterior superior spine. The deeper layers of the abdominal wall were much infiltrated by inflammatory products, and their identity was obscured. A large collection of thin brown pus was opened. There was neither gas nor odor. It was then seen that the inner wall of the abscess was formed by the postero-external surface of the ascending colon and cæcum and on this aspect of the cæcum there was a greenish slough the size of a florin. The appendix was found inflamed, but showed no sign of disease arising from within. It was removed and a tube inserted in the abscess cavity. Course of illness after operation. There was a profuse discharge of bile from the tube on the following day, and it was then apparent that the case was one of retroperitoneal abscess from perforation of a duodenal ulcer. As the patient's condition became palpably worse during the next five days, laparotomy was decided on. The peritoneal cavity was normal and no ulcer was seen on the anterior surface of the duodenum. After enveloping, a vertical incision was made through the peritoneum immediately to the other side and parallel to the descending portion of the duodenum. There escaped at once a large quantity of fluid of the same nature as that obtained from the drainage tube. The duodenum thus "mobilized" was quite easily turned forward and to the left, when the perforation was at once apparent. The opening was in the centre of the posterior wall of the descending portion, 1 inch from its beginning. The perforation admitted the tip of the index-finger, and there was hardly any induration of its edges. It was an easy matter to close it by four Lembert sutures, a posterior gastro-enterostomy was quickly done, and the pylorus closed by a ligature. The whole operation occupied less than half an hour. After the operation there was a distinct rally, but during the afternoon the signs of collapse were apparent, and the patient died at noon of the following day.

¹⁰ Telford and Radley. On Retroperitoneal Perforation of the Duodenum. *Brit Med Journ*, May 4, 1912, p. 1002.

OCCLUSION OF THE PYLORUS*

BY CHARLES L GIBSON, M.D.

OF NEW YORK

SURGEON TO THE FIRST (CORNELL) SURGICAL DIVISION OF THE NEW YORK HOSPITAL

AND

FENWICK BEEKMAN, M D

ADJUNCT ASSISTANT SURGEON TO BELLEVUE HOSPITAL

SINCE 1895, when von Eiselsberg first suggested occlusion of the pylorus in a case of cancer of the stomach, there has been a growing recognition of the necessity of this step in certain cases of pyloric and duodenal ulcers. It is true that a good many surgeons have been opposed to this additional piece of technic. We do not propose to discuss the advisability of this step, as the purpose of this paper is only to compare the efficiency of the different methods of pyloric closure.

We have been unable to find in any of the recent text-books on surgery any mention of pyloric occlusion. We believe, however, that in certain cases of ulcer of the pylorus or duodenum there is a demand for some further procedure to the gastro-enterostomy. It appears to us that the two main indications for pyloric occlusion are, first, the absence of narrowing of the pylorus in chronic ulcers, and, second, active ulcerations of the pylorus and more particularly of the duodenum. It would also seem proper, if a gastro-enterostomy seems necessary after the closure of a perforating ulcer at the pylorus or duodenum (though this is rarely the case), to perform some form of occlusion, particularly if the closure of the perforation seems unsatisfactory. The rationale of the procedure seems to be the diverting of the entire gastric contents through the gastro-enterostomy so that the ulceration may have a chance to heal.

Pyloric exclusion should not be performed indiscriminately and there should be well-defined grounds for its performance. This rule should be particularly enforced if one of the graver forms of procedure, such as the Eiselsberg unilateral exclusion, is chosen.

In the choice of method we should establish as a principle the adoption of a method possessing a reasonable expectancy of efficiency without unduly prolonging the original operation or adding perceptibly to the ordinary dangers, particularly if the patients are poor operative

* Read before the New York Surgical Society, December 9, 1914

risks. Such a method should be simple in performance, and devoid of danger of hemorrhage or infection. It seems to us that a point to be determined in the future is whether occlusion of the pylorus need be permanent or whether occlusion efficient for some weeks or months only may not suffice to bring about a cure of the underlying conditions.

The principal methods of pyloric exclusion may be divided into four classes

- 1 Cutting away all communication between the stomach and duodenum, such as the von Eiselsberg operation

- 2 Those which only attempt to produce a partial exclusion, as Bartlett's two methods

- 3 Those which produce contractions of the stomach wall by various methods of suture, purse-string and torsion

- 4 Those which aim to bring about compression of the pylorus from without by ligatures (Parlavechio), transplantation of free fascial flaps (Wilms), by compression of the mucous membrane alone (Strauss), or the permanent exclusion by foreign material, such as the magnesium band described by Brewer

Von Eiselsberg, after performing the gastro-enterostomy, sections the stomach between clamps just proximal to the pylorus and closes the sectioned lumen by inversion of their ends (Fig 1). We do not believe that such an operation as von Eiselsberg's fills the requirements which we have laid down, for in the simplest case the amount of work to be accomplished is nearly equivalent to a pylorectomy without the advantage of the radical removal of the lesion, which is obtained by the latter operation. We do believe, however, that in this procedure we are more sure of a permanent occlusion, although we cannot be absolutely certain, as one of us has seen the lumen of the duodenum in a dog become patent after it had been sectioned and its ends inverted. Meyer has suggested the use of Hueftl's wire stretching instrument in section of the stomach, as this procedure undoubtedly shortens the time of the operation.

Biondi recently suggested a method of total occlusion free from the dangers involved by the sectioning of the gut. His method consists of a vertical incision over the pyloric portion of the stomach just proximal to the pyloric ring, which is carried down through the serous and muscular coats. These coats are then dissected from the mucosa, leaving a tube of mucous membrane (Fig 2), which is doubly ligated with chromic gut and divided between them with the actual cauters (Fig 3), the serous and muscular coats being closed over the stumps with one of the ordinary peritoneal sutures. It appears to us that this is

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a rather difficult and prolonged technic and that the danger of opening the lumen of the intestine is considerable. This author reports that in his experimental work in no case did the lumen of the stomach become patent. We, however, were less fortunate, for in one of our dogs at autopsy it was found that the lumen was patent.

Reichel and Dobertin section the stomach close to the distal portion in the same manner as von Eiselsberg, and then perform gastro-enterostomy by anastomosing the proximal end of the stomach to the

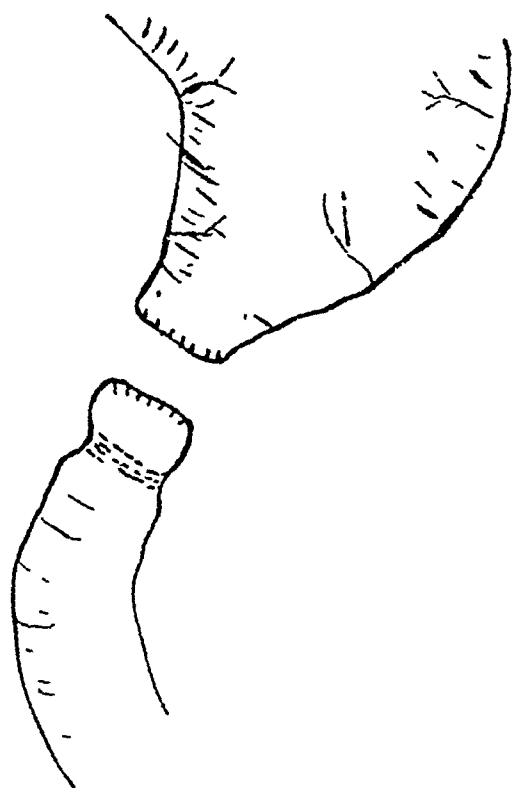


FIG 1—Von Eiselsberg's method of sectioning the pylorus

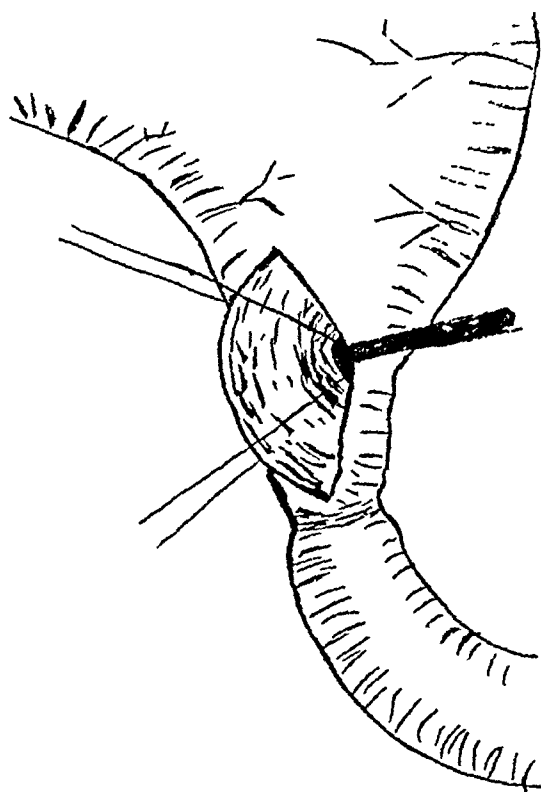


FIG 2—First step in Biondi's method. The muscular and serous coats have been separated from the mucous membrane

side of the loop of jejunum (Fig 4). Brun, in like manner, joins the proximal end of the pylorus to the duodenum, just distal to the site of the ulcer. These methods, though satisfactory as to the occlusion, are full of dangers because of the difficulties of technic and additional risk of leakage.

Of the methods in the second class, Bartlett has published two which he claims are more simple, take less time, and encounter fewer blood-vessels than the transverse complete division of the organ, and that experimentally they produce similar results. The first of these methods

consists of partial transverse section of the prepyloric portion of the stomach between two clamps. The incision starts at the greater curvature and extends up to within one inch of the lesser curvature, the cut edges of the stomach are then closed by means of a whip stitch, the serous coat being sutured over the edges or together across the gap. In his second method (Fig 5) he forms a septum across the centre of the lumen of the stomach. The procedure is as follows. A skewer is passed through both coats of the viscus, a short distance above the

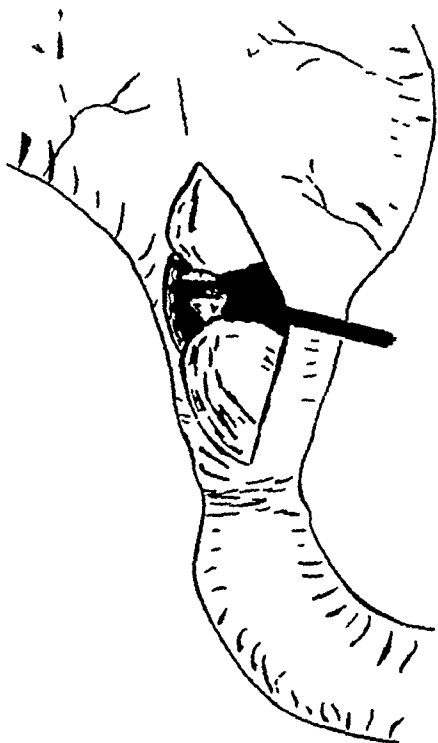


FIG 3—Biondi's method. Mucous tube has been doubly ligated and divided with actual cautery. Muscular and serous coats are ready to be sutured over the divided ends.

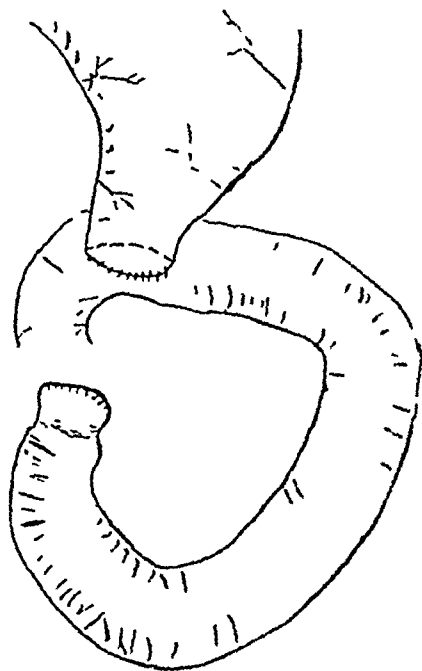


FIG 4—Reichel's method. Div. of pylorus with anastomosis of proximal end into the jejunum.

greater curvature, and out again through both coats, about the same distance under the lesser curvature, a crushing clamp is then applied just below the point where the skewer lies, thus grasping the four coats of the stomach. The tissue distal to the clamp is removed and the coats are sutured together with three or four chromic gut mattress sutures. The clamp is removed and the cut edges are further strengthened by a running whip stitch, and the peritoneal coat of the anterior wall of the stomach is closed over this with continuous Lembert suture. The technic in both these methods is rather difficult and we believe it adds to the risk of peritonitis from leakage.

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Girard contracts the lumen by means of a pyloroplasty. A transverse incision is made down to the mucous membrane at the pyloric end of the stomach and is then closed longitudinally—a reversal of the Heinecke-Mikulicz procedure. Objection to this method is the same as that of the Bartlett.

In the third class of methods which attempt to occlude the pylorus by various means of infolding sutures and torsion, we need only mention the principal ones. W. J. Mayo and Moynihan advise constriction

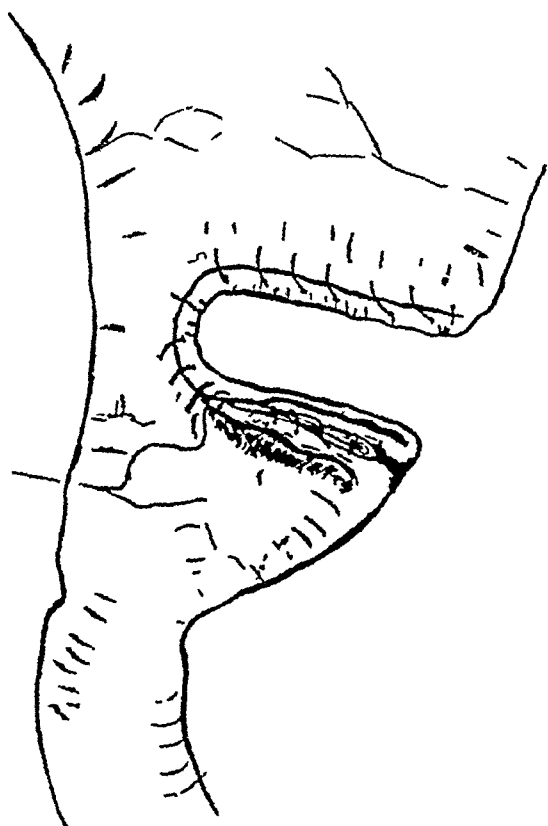


FIG 5—Bartlett's second method of partial transverse division of the pylorus

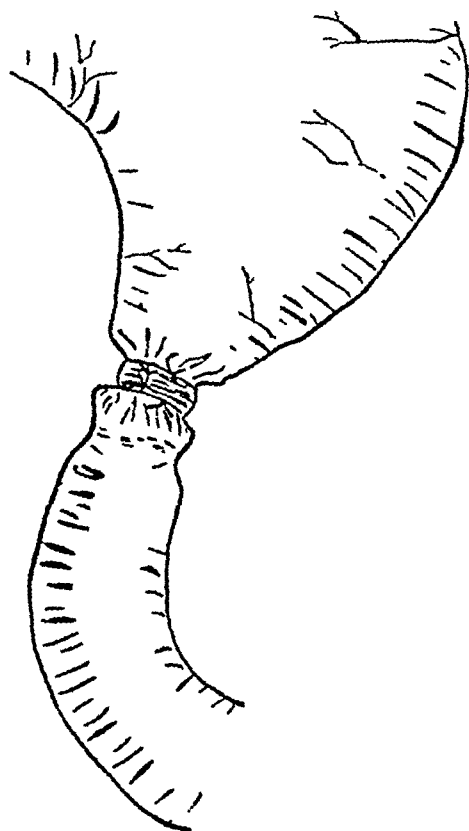


FIG 6—Wilm's method of pyloric occlusion. Suturing of fascial band around the pylorus

of the pylorus by means of infolding the walls with peritoneal sutures. This method would seem most applicable to those cases in which the ulcer has caused the viscus to become adherent to some surrounding structure from which it would be inadvisable to separate it. Mertens suggests two methods of occlusion. The first, by applying four peritoneal sutures across the stomach and duodenum, two proximal to the pyloric ring and two distal to it. They are tied and the loose ends of the sutures are again tied together, producing a longitudinal as well as a transverse infolding. His second method needs only be men-

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tioned, it is simply an attempt at occlusion by torsion of the pyloric portion of the stomach

The most popular method of pyloric occlusion has been that of compression, especially the one described by Wilms (Fig 6), where a strip of fascia is sutured around the viscus. The fascia is obtained from the fascia lata or from the anterior rectus sheath, it should be about one-half inch wide and three or four inches long. A clamp is passed through the gastrocolic omentum at a point just under the greater curvature of the stomach and carried out through the gastro-hepatic omentum at a corresponding point on the lesser curvature, the ends of the strip of fascia then being grasped by a clamp and drawn through behind the pylorus. In doing this, we find it is of importance that the muscle surfaces of the fascia should be approximated to the serous coat of the stomach. The strip of fascia is then drawn around the pylorus with sufficient tension to occlude its lumen, the ends are sutured together with chromic catgut, and a few stitches are also taken binding the fascia to the stomach.

Silk, cotton and wool, and linen ligatures have at times been used to produce the desired constriction. They are tied around the pylorus sufficiently tight to occlude, care being taken that the gut is not strangulated. It has been found, however, that these sutures, if drawn tight enough to occlude, cut through the intestinal wall and are finally passed out through the intestines. Brewer has used small bands of aluminum which he says are easily applied with sufficient tension to produce complete occlusion of the pylorus. He also suggests that they might be useful to produce temporary occlusion, as after their removal he has shown that the intestine has again become patent. He especially recommends their use in cases where the ulceration has caused bleeding. However, his work is only experimental as he has never had occasion to use this method upon a human being. We are inclined to believe that it would be a rather dangerous procedure to use a rigid, almost non-absorbable material for compression of the intestines.

Hoffman divides the serous and muscular coats, sutures the fascia around the mucous membrane, and closes the two outer layers over it. Recently, Strauss has performed some interesting experiments on dogs by dissecting out the mucous membrane tube of the pylorus in a similar manner to that in which Biondi does, but instead of sectioning the intestine he ligates it with either a band of fascia or a wide strip of tape, finally closing the muscular and serous coats over it. We believe these two last methods are impracticable because of the difficulty in separating

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more as a matter of expediency than actual necessity, we would recommend unreservedly the less severe measures, as constriction or infolding with sutures. Of the former method, we believe at present that the application of a free flap of fascia, when it can be applied, promises the best result. If, however, the adhesions around the pylorus are such that it would be inadvisable to separate them, we would recommend that the constriction be produced by one of the methods of infolding with peritoneal sutures. The more radical procedures, such as the Eiselsberg unilateral exclusion, we would reserve for the severer lesions which call unquestionably for certainty of results. We feel, however, that even in these cases this particular operation will seldom be indicated, for, as a general principle, these severer lesions would probably be better treated by resection, which in severity but little exceeds the unilateral exclusion.

TABLE I

BIONDI'S METHOD

Exp No	Duration	Result	Remarks
10	2 days		Death from peritonitis due to leakage
11	26 days	Obstruction complete	
12	29 days	Lumen patent	

TABLE II

OCCLUSION BY FASCIAL BAND

Exp No	Duration	Result	Remarks
1	91 days	Occlusion incomplete	
2	4 days	Occlusion complete	Duration of life too short for any conclusion
3	88 days	Occlusion incomplete	
5	21 days	Functionally complete	X-ray findings correspond to those found at autopsy
14	28 days	Occlusion incomplete	
15	56 days	Occlusion incomplete	
16	56 days	Occlusion incomplete	

TABLE III

OCCLUSION BY SILK LIGATURE

Exp No	Duration	Result	Remarks
4	24 hours	Complete obstruction	Duration of life too short for any conclusion
6	4 days	Occlusion complete	Duration of life too short for any conclusion

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in none was there found complete occlusion. In all dense adhesions had formed around the ligature and the silk was found in every instance imbedded deep in the thickened wall. Here the thickening had produced some stenosis but not to the same degree as in the case of the fascia.

Two dogs were operated upon by ligation of the pylorus with ten-day chromic catgut (Table IV). At autopsy, the pylorus was found entirely normal except for the presence of a large number of dense adhesions. No evidence of a ligature could be found in either case. In one of the animals the X-ray taken ten days after operation showed no evidence of patency of the pylorus, all the bismuth apparently passing through the gastrojejunal anastomosis, and at autopsy there was not the slightest obstruction. Judging from this, it may be possible that we have found a method which will produce a temporary obstruction.

Our work with the Biondi method of occlusion was disappointing, first, because of the difficulty in technic and the ease in which the lumen is opened, and, second, because of the uncertainty of its duration.

The experimental results obtained by the fascial transplants have been more or less borne out by their clinical applications. We find in these cases after operation, by means of the X-ray, a certain amount of bismuth passing through the pylorus though the greater amount seems to be carried off by the gastro-enterostomy into the jejunum. Though theoretically this is a failure, practically the results are nearly perfect, as the symptoms usually disappear and the patients are apparently cured. Accordingly, the question may be raised as to whether a complete occlusion of the pylorus is needed in these cases or whether simply a slight constriction of its lumen will produce the desired result. This idea is more or less borne out by the end results obtained by such methods as the Bartlett, which only attempts to produce a partial occlusion.

If simple ligation of the pylorus with a permanent ligature brought any assurance of efficiency it would naturally be the simplest and easiest method to perform. Some authors, particularly Lambotte, have claimed its superiority over all other methods, but the bulk of evidence does not appear to corroborate this view. With chromic gut ligatures constricting the pylorus we cannot expect success. Occlusion may be present for a short time, until the ligature is absorbed, but later the lumen is sure to regain its patency.

After considering our experiments and reviewing the literature, we have come to the following conclusions:

For the border-line cases, when occlusion would seem to be indicated



FIG 8 —Dog No 16 Occlusion by Wilms' method of fascial trans-
plant Note the adhesions

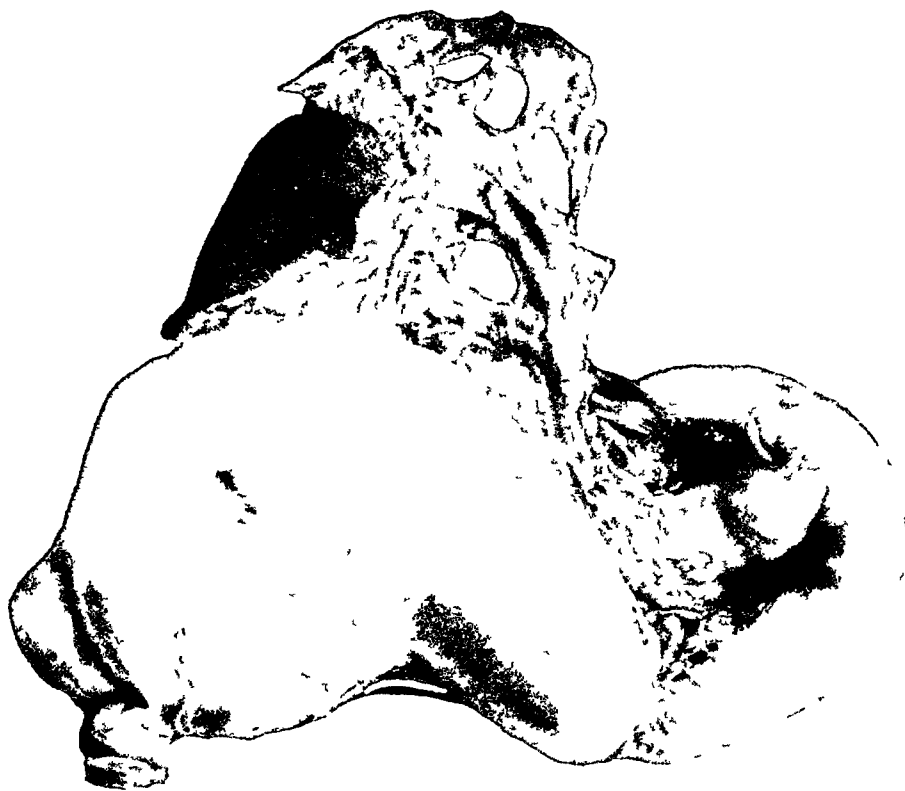


FIG 7 —Dog No 3 Occlusion by Wilms' method of fascial transplant
Though occlusion is not complete a marked constriction is present

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Exp No	Duration	Result	Remarks
7	71 days	Occlusion incomplete	From the X-ray findings there is no evidence of pyloric patency
8	3 days	Complete occlusion	From the X-ray findings there is no evidence of pyloric patency
17	11 days	Occlusion incomplete	
18	10 days	Occlusion incomplete	

TABLE IV

OCCCLUSION BY CHROMIC CATGUT

Exp No	Duration	Result	Remarks
9	38 days	Incomplete occlusion	In the X-ray pictures taken 10 days after operation, no evidence of pyloric patency
13	29 days	Incomplete occlusion	Except for a few adhesions, no evidence of chromic gut ligature

EXPERIMENTAL WORK ON DOGS

EXPERIMENT No 1—October 9, 1914 Fox terrier, female

Operation—Posterior gastrojejunostomy was done and the pylorus obstructed by suturing a strip of fascia $\frac{1}{4}$ inch wide, taken from the anterior sheath of the rectus, around the pylorus

X-ray Findings—Extensive adhesions show in roentgenograms made immediately after the administration of the bismuth. The pylorus is partially patent. The cap is filled, and in the roentgenograms made twenty minutes later there is evidence of bismuth in the descending duodenum.

Result—Dog killed January 8, 91 days after operation. Gastro-enterostomy patent, not many adhesions around the pylorus, pyloric lumen fairly wide open though there is some stenosis present.

EXPERIMENT No 2—October 9, 1914 Brown mongrel, male

Operation—Posterior gastrojejunostomy was done and the pylorus obstructed by suturing a strip of fascia $\frac{1}{4}$ inch wide, taken from the anterior sheath of the rectus, around the pylorus.

Result—Was found dead on October 13. Autopsy performed (death from distemper). Gastro-enterostomy was found patent and the fascia appeared to be loosened so that a point of the forceps could be passed through the pylorus.

EXPERIMENT No 3—October 12, 1914 Bulldog, female

Operation—Posterior gastrojejunostomy was done and the pylorus obstructed by suturing a strip of fascia $\frac{1}{4}$ inch wide, taken from the anterior sheath of the rectus, around the pylorus.

X-ray Findings—Extensive adhesions with only a fleck of bismuth in the cap. Duodenal opening, opened, stomach emptying rapidly.

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Result—Dog killed January 8, 88 days after operation Autopsy Gastro-enterostomy patent, pylorus covered with adhesions, fascial transplant present, causing stenosis though complete occlusion is lacking

EXPERIMENT No 4—October 12, 1914 Rough-haired terrier, male

Operation—Posterior gastrojejunostomy, pylorus being obstructed by double silk ligature tied tight enough to exclude the lumen of the stomach without causing strangulation

Result—Dog found dead the following day Death from closed loop Gastro-enterostomy was found patent but the jejunum at this point had become twisted, causing an obstruction in the gut This resulted in a closed loop between the pylorus and gastro-enterostomy This loop was much distended and contained bile

EXPERIMENT No 5—October 15, 1914 Brindle mongrel, female

Operation—Posterior gastrojejunostomy, pylorus obstructed by suturing a strip of fascia $\frac{1}{4}$ inch wide, taken from the anterior sheath of the rectus, around the pylorus

X-ray Findings—Rapid evacuation through gastro-enterostomy Extensive adhesions around pylorus No evidence of bismuth in cap or descending duodenum The roentgenograms were made after the dog died and this accounts for the lack of peristalsis in small intestine

Result—Dog died November 5, while being anesthetized with chloroform, 20 days after operation Autopsy Gastro-enterostomy was found patent, pyloric obstruction is complete No water held in stomach passing through pylorus The fascia which constricts the pylorus is covered with a layer of peritoneum

EXPERIMENT No 6—October 15, 1914 Terrier, female

Operation—Gastrojejunostomy Pylorus obstructed by tying No 5 silk ligature around it, tight enough to obstruct its lumen without strangulation

Result—Dog died October 19, 1914 Autopsy Obstruction between pylorus complete Cause of death pyæmic abscess of liver

EXPERIMENT No 7—October 21, 1914 Bull terrier, male

Operation—Gastrojejunostomy Pylorus obstructed by tying No 3 silk ligature around it

X-ray Findings—Gastro-enterostomy, extensive adhesions around the pylorus No evidence of pyloric patency

Result—Died December 31, 71 days after operation Cause of death distemper Gastro-enterostomy found patent, large number of thick adhesions found around the pylorus On opening the duodenum, pylorus found patent though lumen not as large as normally Silk found imbedded in adhesion

EXPERIMENT No 8—October 21, 1914 Terrier, female (young puppy)

Operation—Gastrojejunostomy Pylorus obstructed by tying No 3 silk ligature around it

Result—Found dead October 24 Gastro-enterostomy patent Obstruction found complete No cause of death could be found except the age of the puppy

EXPERIMENT No 9—October 21, 1914 White mongrel terrier, female

Operation—Gastrojejunostomy. Pylorus tied off with No 2 chromic gut suture

X-ray Findings—Extensive adhesions, no evidence of bismuth in duodenum or cap, bismuth passing out through gastro-enterostomy

Result—Dog died November 28, 38 days after operation Cause of death

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malnutrition The gastro-enterostomy was found patent A large amount of adhesions were found binding the pylorus to the liver and adjacent loops of intestine The pylorus was opened No signs of chronic ligature could be found

EXPERIMENT No 10—October 31, 1914. Black setter, male

Operation—Gastro-enterostomy Pylorus closed in following manner longitudinal incision 1 inch long made over superior surface of pylorus down to the mucous coat Muscular and serous coats were then dissected free from this tube of mucous membrane, and it was ligated with chromic gut in two places Tube was sectioned with cautery and serous and muscular coats were sutured with silk

Result—Found dead November 2, 1914, 2 days after operation Cause of death general peritonitis, leakage of obstruction

EXPERIMENT No 11—November 4, 1914 Terrier, male

Operation—Posterior jejunostomy Pylorus closed in following manner longitudinal incision 1 inch long made over the superior surface of pylorus down to the mucous coat Muscular and serous coats were then dissected free from this tube of mucous membrane and it was ligated with chromic gut in two places Tube was sectioned with cautery and serous and muscular coats were sutured with silk

Result—Found dead November 30, 26 days after operation Cause of death distemper Gastro-enterostomy found patent There were many adhesions around the pylorus On opening the duodenum close to the obstruction the pylorus was found entirely obstructed

EXPERIMENT No 12—November 4, 1914 Irish terrier, female

Operation—Posterior jejunostomy Pylorus closed in following manner longitudinal incision 1 inch long made over superior surface of pylorus down to the mucous coat Muscular and serous coats were then dissected free from this tube of mucous membrane and it was ligated with chromic gut in two places Tube was sectioned with cautery and serous and muscular coats were sutured with silk

Result—Dog died October 5, 29 days after operation Cause of death distemper Gastro-enterostomy patent Large amount of adhesions around pylorus, lumen of which, however, is entirely open

EXPERIMENT No 13—November 10, 1914 Black terrier, female

Operation—Gastroduodenostomy Pylorus obstructed by tying ligature of No 1 chromic gut around it

Result—Killed December 9, 29 days after operation No trace of chromic gut and no trace of any narrowing of the pylorus

EXPERIMENT No 14—November 10, 1914 Big brown hound, male

Operation—Posterior gastro-enterostomy and obstruction by fascia

Result—Died December 8, 28 days after operation Cause of death distemper Water trickles through by gravity from stomach and the lumen is obviously patent The fascia is in place and is vitalized

EXPERIMENT No 15—November 13, 1914 Tan mongrel, male

Operation—Posterior gastrojejunostomy was done, the pylorus being obstructed by suturing a strip of fascia $\frac{1}{4}$ inch wide, taken from the anterior sheath of the rectus, around the pylorus

Result—Dog killed January 8, 56 days after operation The liver is very

OCCLUSION OF THE PYLORUS

- Wilms Deutsche med Wchnschr, 1912, vol xxxviii, p 1332
 Strauss Jr A M A, 1914, vol lxiii, p 1525
 Polya Zent f Chir, 1913, p 1329
 Bircher Zent f Chir, 1913, p 1331
 Girard ANN SURG, 1912, vol lv, p 155
 Mertens Deutsche Zeit f Chir, 1914, vol cxxix, p 262
 Brun Zent f Chir, 1914, p 441
 Hoffman Zent f Chir, 1914, p 1331
 Dobertin Zent f Chir, 1914, p 1441
 Meyer ANN SURG, 1913, vol lviii, p 697
 Biondi Quoted by Strauss
 Reichel Quoted by Perthe
 Perthe Deutsche Zeit f Chir, 1914, vol cxxix
 Mayo, W J ANN SURG, 1914, vol lx, p 220
 Moynihan Trans Amer Surg Assoc, 1903, vol xxi, p 135

Convalescence—Convalescence was smooth Discharged 16 days after operation when it was noted that the patient was taking soft solid diet with no pain and no gastric distress

Notes—Reexamined October 5, 1914 Patient presented every appearance of good health and well-being He complains of occasional feeling of fulness in left side of epigastrium Digestion good—eats anything Weighs 140 pounds, a gain of 14 pounds in three months

Gastric Analysis—Total quantity 20 c c Free HCl 50, total acidity 90 Faint bile stain Guaiac negative X-ray shows conclusively that the exclusion is absolute, as bismuth is seen distinctly coming out of the gastro-enterostomy opening while not a vestige of it appears from the pylorus

Patient, William M, aged thirty-four

Gastro-enterostomy with occlusion of the pylorus by strip of fascia on October 12, 1913

Patient has a very typical history of gastric ulcer verified by various examinations Also has lues, alcohol and morphine habit Has been in several hospitals

The strip of fascia was taken from the abdominal wall The operation failed to improve the patient and he had a great deal of distress following infection of the wound which broke down, and he left the hospital no better off than when he entered

Considering the various complications and the patient's mental state, it is a little hard to say to what extent the operation *per se* was a failure

Patient, Michael H, aged forty-one

Symptoms of gastric ulcer for several years Has been in various hospitals and two operations have been performed on him He states that one operation was for the removal of two ulcers on the stomach, the other operation we know consisted in a ligation of the gastric artery

At operation a saddle-shaped ulcer, juxtapyloric on the lesser curvature, was found No evidences of any previous excision of ulcer A strip of fascia, taken from the thigh, was placed around the portion of the stomach proximal to the ulcer bearing area

The patient had a good convalescence, leaving the hospital two weeks after operation Unfortunately, all attempts to trace him since have failed It is fair to believe that this operation brought relief

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APPENDICULAR OBLITERATION

these, 112 (32.4 per cent) were found normal and 388 (77.6 per cent) presented well marked evidence of active or already established inflammatory changes. Of these 388 there were 71 (18.3 per cent) which had undergone complete obliteration. It is a *reductio ad absurdum* to maintain that more than three-fourths of the entire population have been subject to appendicitis as we know the disease. We must therefore assume that chronic infective processes may go on in the appendix without producing diagnostic symptoms, or that the appendix normally undergoes certain retrogressive processes in the nature of atrophic fibrosis and obliteration. The latter view has been strongly championed by Ribbert. The argument in favor of physiologic involution of the appendix rests chiefly on the fact that the incidence of oblitative processes increases directly as the age, reaching as high as 50 per cent in the seventh decade of life. When we reflect, however, that an appendix once obliterated is always obliterated the argument loses much of its force, since it is obvious that from whatever cause obliteration proceeds the percentage of frequency must rise with increasing years, just as in the case of gall-stones, which nobody considers a physiologic process for that reason. It is entirely probable that the process is favored by the general atrophy and sclerosis associated with increasing age, but to assume that it is an example of isolated old age in a particular organ, or, what Gowers speaks of as abiotrophy, is no longer tenable. Against this view are (1) the early age at which the process may begin. Obliteration, according to McCarty, may begin as early as the fifth and be complete at the tenth year of life. In the second decade from 3 to 17 per cent show partial to complete obliteration. This is the period of active growth rather than of degenerative processes. (2) In an operative series the incidence of obliterated appendices does not increase directly with the age, but follows closely the curve of inflammatory diseases of the appendix. Thus in 100 consecutive cases the age incidence was as follows:

First decade	0	Fifth decade	18
Second decade	10	Sixth decade	11
Third decade	31	Seventh decade	3
Fourth decade	27		

The greatest number of cases fell between 20 and 30 years, corresponding to the period most susceptible to recognized appendicitis.

(3) Clinical evidence points clearly to the importance of previous appendiceal inflammation. In 52 consecutive cases operated upon with a diagnosis of chronic appendicitis, 30 gave a history of previous sharp

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BY DAMON B. PFEIFFER, M.D.

OF PHILADELPHIA

MUCH confusion exists in the minds of surgeons as to the significance of the term chronic appendicitis. As it is usually understood it refers either to a state of persistent low grade inflammation involving one or more coats of the appendix, or to recurring attacks separated by intervals during which it may be more or less free from the process or products of inflammation.

As the term is used by the pathologist it may refer not only to the above conditions but also to the results of previous inflammation of the appendix, as evidenced long after the infective process has passed by thickenings, fibrosis, cicatrices, strictures, kinks, and by destruction, absorption and replacement of various portions of its coats, particularly the mucosa. In the former instance the process is still active, though it may be sluggish, in the latter condition it is inactive except as its results may cause disordered conditions. It is the difference between a pathological process and a terminal pathological state. A good parallel may be seen in the chronic endocarditis which, still harboring microorganisms, continues slowly to attack the valves of the heart, as compared with the *so-called* chronic endocarditis which has become sterile and quiescent but acts through the defects and distortions of the leaflets which have been created. Active chronic disease of the appendix betrays itself under the microscope by œdema, hyperæmia, or by the cellular infiltrations which are the hallmarks of chronic infective processes. At a later time the evidences of an active process may be entirely lacking and in their stead we find only the end results above mentioned. It would lead to more accurate thinking and analysis of the true conditions if we were to speak of the former group as chronic active appendicitis and drop the term appendicitis entirely as descriptive of the latter condition, calling it instead appendicular sclerosis or obliteration, as the case may be. We would then be brought forcibly to face with the fact that not all chronic active appendicitis is productive of symptoms, or better perhaps, recognizable symptoms. In a series of 5500 appendices removed by Dr John B Deaver, 500 were removed in the course of a laparotomy for other conditions. Of

* Read before the Philadelphia Academy of Surgery, December 7, 1914

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of lumen In these types of appendicitis permanent peri-appendicular adhesions will often be formed The case above reported, of rapid obliteration following acute appendicitis with obliteration as a sequel, probably belonged to this class More frequent than this is the sclerosis and obliteration which results from chronic catarrhal and interstitial processes I have examined many appendices removed incidentally in the course of abdominal operations for conditions foreign to the appendix in which unmistakable evidences of chronic active inflammation of the organ were present This occurs not infrequently in the entire absence of any of the recognized symptoms or signs of appendicitis That this is true is also shown by the large number of cases which present evidences of antecedent inflammation without a history suggestive in any way of appendicitis All the steps of obliteration can be traced Cellular infiltration occurs in the outer coats and excites the deposit of fibrous tissue which impedes the blood and lymphatic circulation, renders the organ less elastic, and thus subjects the mucosa to increasing pressure during the periods of œdema and congestion consequent upon the more or less severe exacerbations of infection In addition to this there is a gradual contraction of the newly-formed diffuse cicatricial tissue Under these influences the mucosa becomes thin, the glands gradually disappear, the mucosal stroma, and often the lymphoid tissue, undergoes pressure atrophy and disappears The encroaching fibrous tissue joins across the gap now microscopically minute and appendicular obliteration is complete Such a process may go on without involving the serosa of the appendix No adhesions are excited and so slow and inconspicuous may be the whole process that symptoms of any moment may not be called forth, and if they do exist they are most often misinterpreted Thus, in the 52 cases operated upon with a diagnosis of chronic appendicitis 8 had had a long standing history of indigestion prior to the development of acute attacks and 7 had mild local symptoms preceding a definite seizure which made the diagnosis

The cause of the symptoms in appendicular obliteration is not only an interesting but important consideration In what manner does an appendix cause symptoms after it has been reduced to a thin fibromuscular cord devoid of any chronic inflammatory process? That simple removal of such an appendix does abolish symptoms in the majority of cases there can be no question On the other hand, it is a well-known fact that appendectomy, particularly in this type of case, does not always cure or relieve the symptoms In 100 cases of chronic appendicitis followed by Stanton with reference to end result, 64 were

attacks and 17 had had mild local symptoms. In 48 cases in which the appendix was removed incidentally, 5 gave a history of sharp, definite attacks in the past, 9 of indefinite probable attacks, and 6 complained of chronic indigestion. The history of one case is particularly significant. A man, aged twenty-three, was admitted to the German Hospital with a diagnosis of obstruction of the bowels. Nine months previously he had had a severe attack of acute appendicitis. At operation there were found peri-appendicular adhesions, beneath one of which a knuckle of small intestine had been caught and strangulated. The appendix itself was completely obliterated and inactive.

(4) Operative findings usually suggest previous inflammatory processes. It is not common to find an obliterated appendix swinging freely on a normal meso-appendix. Usually the mesentery is contracted, kinked, or absent. The appendix is frequently subcæcal, paracolic, or bound beneath the terminal mesentery. Often it is subserous. Peri-appendicular adhesions definitely inflammatory in origin were present in 25 per cent of this series. The attempt of Lane and his followers to attribute most of the appendicular scleroses and obliterations to the consequences of ptosis seems forced in view of the numerous instances of omental and pelvic adhesions which do not admit of any such explanation. That many obliterated appendices do not present peri-appendicular adhesions seems to be due to two facts, namely, the facility with which simple plastic adhesions are later spontaneously released by natural processes leaving no trace behind, and also to the nature of the process of obliteration, which takes two chief forms, and leads us to a consideration of the fifth and pathological reason for assigning infection as the cause of the process.

(5) Obliteration occurs as the result of certain types of acute appendicitis or in consequence of chronic infection of a persistent character with or without exacerbations. It is not exceedingly uncommon to find appendices the mucosa of which has become completely gangrenous without gangrene of the outer coats. This is a consequence of a severe mucosal infection usually aided by increased intra-appendiceal pressure due to proximal blockage of the lumen. If now the obstruction ceases to operate as by the discharge of a concretion into the cæcum or by the softening of a strictured segment, drainage will take place into the cæcum, the mucosa will slough away leaving granulating surfaces which will cohere before epithelialization can take place by continuity from the cæcum. Or, if a perforation occurs at one point and the patient be fortunate enough to recover without removal of his appendix, the end result will be a fibromuscular vestige devoid

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appendix itself The appendix in common with other portions of the alimentary tube has no perception for pain or power of localization Its sympathetic nerve supply does not possess this ability and it is doubtful if any spinal fibres reach the appendix. Local symptoms are called forth only by inflammation propagated to other structures possessing sensibility or through the medium of traction upon structures which have spinal innervation, normally the meso-appendix, abnormally acquired adhesions

In these chronic sclerotic or obliterated appendices, therefore, it is not the inert appendix that is responsible for localizing symptoms, but its shortened and fibrous meso-appendix, the acquired adhesions to adjacent mesentery or parietes, or adhesions of the cæcum, colon or small intestine, the consequences of peritoneal infection and, most important, retroperitoneal lymphangitis, which disturb the motility of the bowel and under conditions of distention or activity or during peristalsis excite pain The appendix in many cases acts as a guy rope attached to the tip of the cæcum preventing foreshortening and emptying of the cæcum by the longitudinal muscles

Disturbance of function of the ileocæcum manifests itself by a further train of symptoms, chief of which is constipation It is probable that in some cases chronic toxic manifestations are a result Just what proportion of the "grisly troop" enumerated by Lane and Metchnikoff are due to this cause remains to be determined

Appendectomy releases the cæcum from the tether of an adherent appendix and the contracted meso-appendix At times other symptom-producing adhesions are released as well In other cases through ignorance of the exact organic cause of symptoms or because of operative difficulties the essential factors are left behind when the appendix has been removed It is asking too much to expect that simple appendectomy will relieve all symptoms due not only to the appendix but also to complications secondary to the appendicular disease but no longer dependent upon it Just what constitutes a normal arrangement of the ileo-cæco-colic region, how much divergence may occur without symptoms, what type and situation of adhesions are most troublesome, and how to remedy them, are questions that do not at present permit an answer, but it is clear that the attachments of the bowel in the ileo-cæcal region have a most important bearing upon function and symptoms and that it is the surgeon's duty at present to observe and digest before generalizing

In this series but one case of associated Lane's kink and Jackson's membrane was observed, and in this instance there were omental ad-

cured and 36 were unsatisfactory, in that relief was not obtained or other lesions were found to have been the cause of the symptoms. Graham and Guthrie reported 85 per cent of cures or improvement, 10 per cent followed by return of symptoms, and 5 per cent unimproved. Scudder and Goodall attempted to follow 3000 appendectomies done in the Massachusetts General Hospital, but were able to trace only 640. Of these 94.6 per cent were cured, but the returns fell so far short of the entire number that this higher percentage is not convincing.

The reasons for failure are various. It is granted that a certain small percentage represents mistakes in diagnosis, the lesion being in no way connected with the appendix or the adjacent bowel. The greatest interest, however, centres in other conditions of the ileocaecum and ascending colon about which it is being attempted to build up pathological and clinical entities. The most important of these are caecum mobile, pericolic membranes and Lane's ileal kink. The discussion of these conditions is not the purpose of this paper, but I wish merely to point out that it is quite unnecessary to refer all failures of appendectomy to the existence of special conditions such as those mentioned.

There are three types of symptoms referable to the obliterated appendix: (1) Those which are referred to other regions of the abdomen, most commonly the epigastrium, (2) local symptoms, (3) general symptoms consequent upon disturbance of function of the bowel.

In this series 4 cases presented epigastric symptoms alone. In 6 others epigastric symptoms were combined with local symptoms. In 2 cases the symptoms were such as to cause suspicion of duodenal ulcer, and in 4 gall-bladder disease was suspected. The occurrence of epigastric symptoms has been plausibly explained by the assumption of reflex nervous influences set up by irritation of the nerve supply of the appendix. In such appendices the ganglion cells of the plexuses of Meissner and Auerbach can easily be seen in a degenerated state. The mechanism exists, therefore, for such action and there seems no reason to doubt that it occurs. Removal of the appendix and with it the irritated ganglionic centres and nerve fibrils should relieve reflex symptoms. Graham and Guthrie's excellent statistics as to cure, above quoted, related particularly to this "dyspeptic" group of chronic appendicitis, and Deaver, Moynihan and many others have placed this type of appendiceal disease on a firm footing as regards its existence and cure.

What is not so well understood, in my opinion, is the fact that local symptoms of appendicular disease do not spring directly from the

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obliteration operated upon by Dr John B Deaver I wish to thank him as well as to acknowledge that my opportunity for observing clinically the conditions to which I have directed attention in this paper are largely due to my association with him In conclusion it should be recognized that.

(1) Appendicular sclerosis and its terminal stage, appendicular obliteration, differ pathologically and clinically from chronic active appendicitis

(2) Three types of symptoms are to be considered (*a*) reflex, due to irritation of the nervous mechanism of the appendix, (*b*) local, due to mesenteric and peritoneal contractions and inflammatory bands or adhesions affecting the appendix, cæcum, ileum or ascending colon, (*c*) consecutive symptoms, general and local, consequent upon disturbed function of the ileocæcal region

(3) Simple appendectomy avails for reflex symptoms, but in local and consecutive symptoms only in so far as the operation permanently frees symptom-producing contractions, sclerosis or adhesions

(4) The determination of these latter conditions and the appropriate treatment therefor awaits further observations and experience

hesions to the parietal peritoneum in the right iliac fossa. Whether the disease of the appendix had been responsible in this instance for the other abnormalities it is impossible to say but the evidence of former adhesive inflammation in this quarter is at least suggestive.

Constipation, at times amounting to intestinal stasis, was the rule in this series. In only 5 were the bowels said to be regular. Two were inclined to diarrhoea. Twenty-five, or about half, were troubled by constipation and in 20 no note was made of the condition of the bowels. The appetite in general was good. Nausea and vomiting were rare, except in connection with a history of definite seizure of pain in previous attacks. Indigestion was admitted in 26, denied in 3, not mentioned in 23. Some form of pain or distress was complained of in every case in which a pre-operative diagnosis of chronic appendicitis was made. It was variously described as dull, aching, dragging, sticking, sharp, crampy and soreness. In 27 cases it was in the right iliac fossa alone, in 5 cases in the epigastrium alone, in 6 cases in both, in 2 it was general, in 3 there were radiations to the right loin and thigh, and in 9 it was aggravated by exercise or activity. The symptoms dated back according to the history from 4 days to 25 years, with an average of more than 5 years. Only 7 gave the duration in months, and in 33 it had been a matter of years. Females predominated, 31 to 21. The leucocytes averaged 8620 per cubic millimetre with a minimum of 4600 and a maximum of 14,500. The few cases which showed some fever, leucocytosis and evidence of inflammatory exacerbation were not instances of complete obliteration. When the obliterative process has reached the cæcal junction there is no longer opportunity for bacterial invasion, a condition dubbed by Morris, protective appendicitis.

The 46 cases of incidental removal of obliterated appendices were distributed among 11 different abdominal diseases, to enumerate which would serve no purpose. It is a curious fact, however probably a mere coincidence, that 7 were removed during operations for extra-uterine pregnancy. During this same period the total number of cases operated on for this condition was 19, so that one in three of the cases of extra-uterine pregnancy presented obliterated appendices. As all these cases gave evidence of chronic or subacute tubal disease it is not beyond the bounds of possibility that the previous appendicitis had been the true starting point of the subsequent extra-uterine pregnancy through the well-known tendency of infective processes from the appendix to communicate disease to the tubes, which in turn would predispose to tubal gestation.

For the privilege of analyzing 100 consecutive cases of appendicular

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anus made through the left rectus muscle, we are forced to the conclusion that the anterior anus is far more convenient and satisfactory to the patient, although it is very hard to convince the patient before operation that the anus in this abnormal position is more desirable than an anus without a sphincter near the normal location. The very best that we can offer a patient today is an abdominosacral operation in two stages, with the anus in front either through the rectus or near the axillary line on the side. I prefer the anterior opening through the rectus.

Dr W. J. Mayo, in the article above referred to, gives two methods of the two-stage operation, one in which a simple colostomy is done in the first stage, and the Kraske operation performed at the second stage, leaving a closed end of sigmoid below the colostomy. "Second For cases in which the growth extends high, in the lower sigmoid." In this group of cases the sigmoid is mobilized down to Douglas' pouch, the fat and glands separated from their posterior attachment to this point, the sigmoid is cut in two and the distal end closed with sutures, and with the attached fat and glands is depressed and the peritoneum closed down over the top of the mass, while the proximal end of the sigmoid is brought up through the left rectus. In this operation he found it necessary to pass a tube through the natural anus into the segment of the intestine above the growth, in order to keep it well cleansed. From seven to twelve days later the growth is removed. He says this method has a slightly higher mortality than the other two-stage operation, in which the sigmoid was not severed at the first operation, and incidentally states, "We had one patient die several days following the colostomy, from perforation of the lower segment," which danger I think may possibly account for the increased mortality reported as following the operation in which the sigmoid was severed at the first operation.

In my own work the shock and the mortality have been decidedly less where I have separated the sigmoid at the first operation. Because of this perforation reported by Dr Mayo in this article, we have modified the technic and now perform the operation as follows.

First A fair sized rectal tube with an eye on each side is passed into the rectum beyond the growth, in order to allow the contents of the sigmoid and rectum above the growth to drain while the operation proceeds.

Second The abdomen is opened in the median line from the umbilicus to the pubes. All the small intestines are packed back into the upper abdomen with gauze, and the sides of the pelvis protected with large gauze packs, the wound being held open by a Balfour

THE MAJOR PROCEDURE FIRST IN THE TWO-STAGE OPERATION FOR RELIEF OF CANCER OF THE RECTUM*

BY ROBERT C. COFFEY, M.D.
OF PORTLAND, OREGON

A FEW years ago the operation for cancer of the rectum was considered quite a hopeless procedure. At the present time the application of the principles of treating cancer elsewhere has made the removal of cancer of the rectum one of the most hopeful of operations for internal cancer, as far as permanent cure is concerned. In our own cases the end results have been decidedly better after removal of cancer of the rectum than removal of cancer of the pylorus. Even at the present day, however, the operation for removal of cancer of the rectum is one of the most formidable operations and has a high mortality. Up until three years ago the mortality following operations of cancer of the rectum was between 20 and 30 per cent. Statistics of the Mayo Clinic show 12 per cent for the year 1913. Crile reports improved results from the application of the principles of anoci-association in operations for rectal cancers. However, nothing has reduced the mortality so much as doing the operation in two stages. In the August, 1912, number of *ANNALS OF SURGERY*, Dr. W. J. Mayo says "The combined abdominosacral operation in two stages has much to commend it and has a mortality of less than one-half that of the abdominoperineal operation in one stage." I believe I am safe in saying that most conservative men at this time are doing a two-stage operation. I believe I am also safe in saying that any operation which includes in its purpose the preservation of the sphincter has not been satisfactory, except in very rare instances. While the condition thus procured would be most desirable, the procedure is not in harmony with the principles on which successful cancer surgery of other parts of the body has been based and as a result the recurrences have been out of all proportion to the benefits derived. Therefore, we must content ourselves with the sacrifice of the sphincter in a great majority of cases, in order to procure a better curative end result.

The sacral anus has not been very satisfactory. In an experience of a considerable number of cases by this method, as well as with the

* Read before the Idaho State Medical Society, October 8, 1914

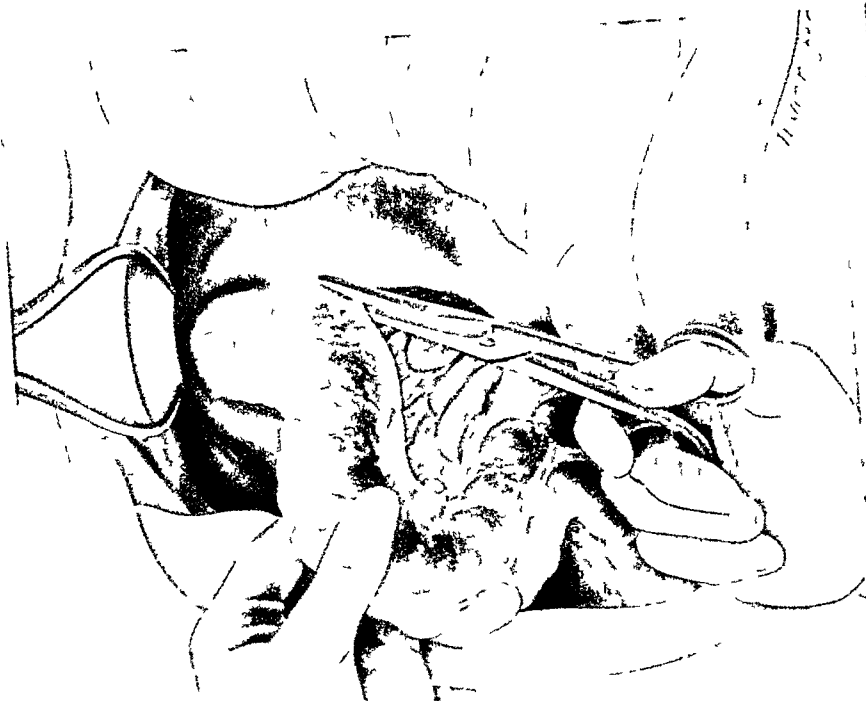


FIG 1.—The sigmoid is mobilized by cutting the peritoneum on each side of its mesentery

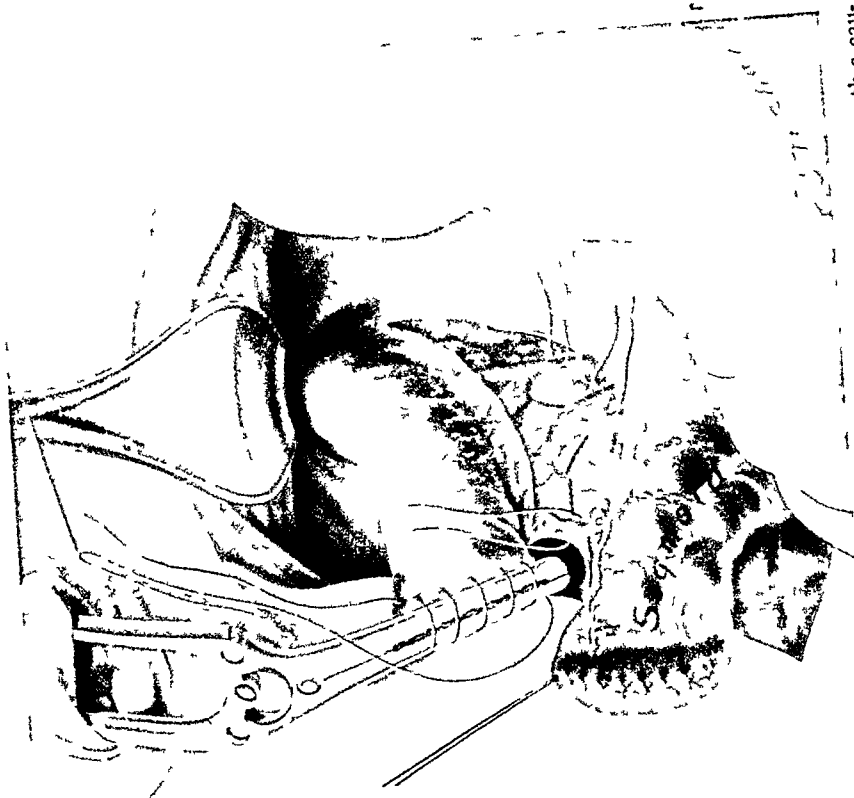


FIG 2.—The sigmoid is cut between ingotribe forceps with a cautery and the forceps heated sufficiently to sterilize the ends. Ends are closed and painted with tincture of iodine, and mesenteric vessels tied

retractor The sigmoid is picked up and mobilized down into Douglas' cul-de-sac as follows The peritoneum on each side is nicked, a blade of a Mayo dissecting scissors is passed between the peritoneum and vessels, and by pushing the partly closed scissors on the tense peritoneum downward, the peritoneum is cut without the injury of any of the mesenteric vessels (Fig 1) The mesenteric vessels are then ligated, the sigmoid is clamped by two angiotribe forceps, and cut between them by cautery, which is allowed to heat the clamp sufficient to sterilize the tissues in the blades (Fig 2) A continuous suture is then passed around the forceps through the intestine, after which the forceps is removed and the suture is continued back across the intestine to the original point of entrance, and the two ends tied together, as shown in Fig 2 Both the proximal and distal ends of the sigmoid are treated in this way, after which the ends are sterilized with pure tincture of iodine The proximal end is wrapped in a pack of gauze and held until the distal end is cared for All the fat and other tissues attached to the distal portion of the intestine are trimmed away so as to make the bulk as small as possible The rectal tube is then pushed up to the upper end of the distal segment, and a very strong double thread is passed through the intestinal wall, through the eye of the rectal tube and out on the other side of the line of suture, and the tube thereby fastened to the sutured end of the gut from its inside (Fig 3) This distal section is again painted over with iodine for most of its length, and its walls grasped on each side by forceps, while traction is made on the rectal tube from below This inverts the large intestine down to the forceps Another bite lower down is taken by the forceps, and the intestine further inverted The tube is then pulled down as far as possible, so that the end of the sigmoid protrudes through the rectum and the peritoneal funnel above is closed by two or three catgut sutures The superior hemorrhoidal artery, which runs in the mesentery of the sigmoid, is doubly ligated and severed between the ligatures, and the lower end with the fat and glands of the mesentery are separated from the sacrum and pushed down The peritoneum then is drawn over by continuous suture, covering in all the fat surface left by mobilizing the sigmoid, and is drawn entirely over the inverted distal end (Fig 4) In women we have, in addition to this line of suture, sutured the uterus and broad ligaments across the pelvis, making the rectum still more extraperitoneal The proximal end is again painted with iodine and drawn through an opening in the middle of the left rectus just below the umbilicus, and sutured to the peritoneum, the aponeurosis and the skin by separate layers of interrupted sutures of linen The

RELIEF OF CANCER OF THE RECTUM

protruding end is clamped and twenty-four to forty-eight hours later is cauterized external to the clamp and the clamp removed

In four of the eight cases which we have done during the past year by this method, we have ligated both internal iliac arteries, in addition to the superior hemorrhoidal artery, at the primary operation. It has seemed that the hemorrhage at the second operation has been decidedly less, and the danger of the first stage has not been materially increased

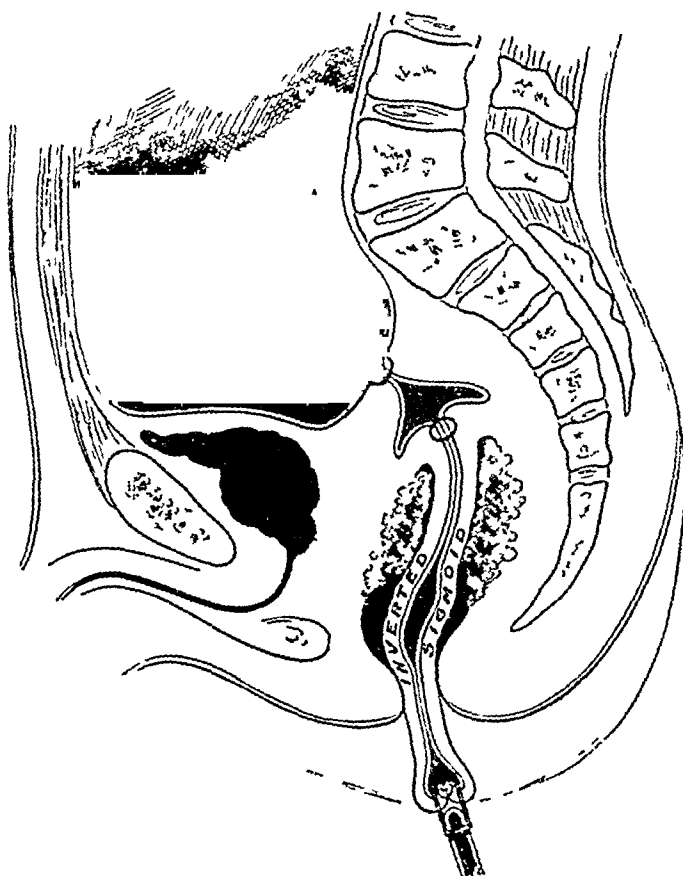


FIG 5 —Sectional view of sigmoid inverted and drawn out through the anus. Also the peritoneum sutured over end of inverted gut

by ligating the internal iliac. Yet, I am not sure that it has many advantages. We have found the patients apparently in the best state for the second operation, from twelve to twenty days after the first. The second operation consists of removing the coccyx and last sacral vertebra and very radical excision of the entire rectum and surrounding connective tissue and fat, also the sphincter. At this time the second operation produces practically no shock and may almost be said to be a minor operation. The peritoneum has not been opened except in one case, and in this case the cancer extended so far up that the operation

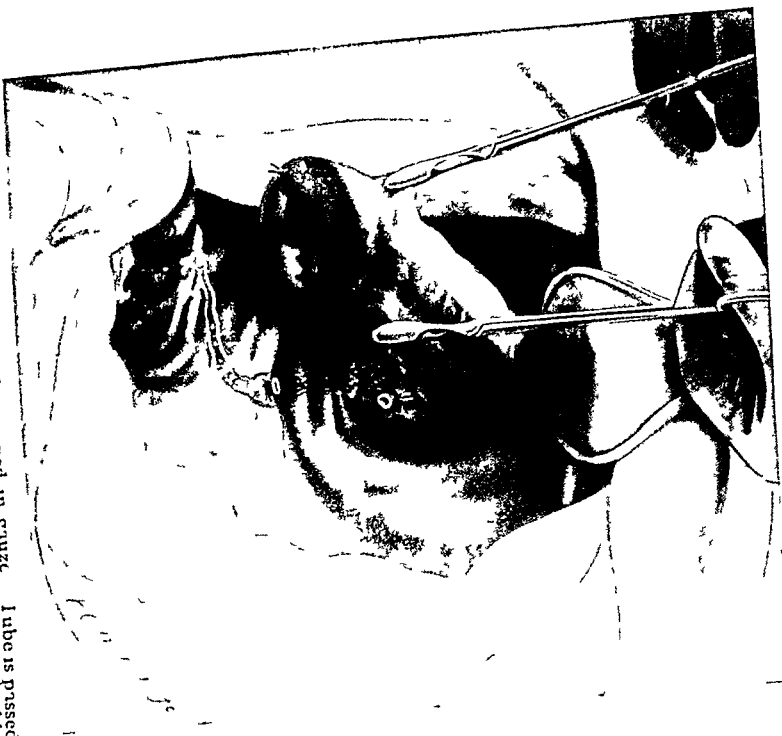


FIG 3.—Proximal sigmoid wrapped in gauze. Tube is passed up to end of distal sigmoid where it is fastened by a strong, double suture, passed through the intestine and eye of tube, and tied on. When the intestine is held by two forceps and traction is made on the tube, inversion is produced. Note the ends of the severed superior hemorrhoidal artery.

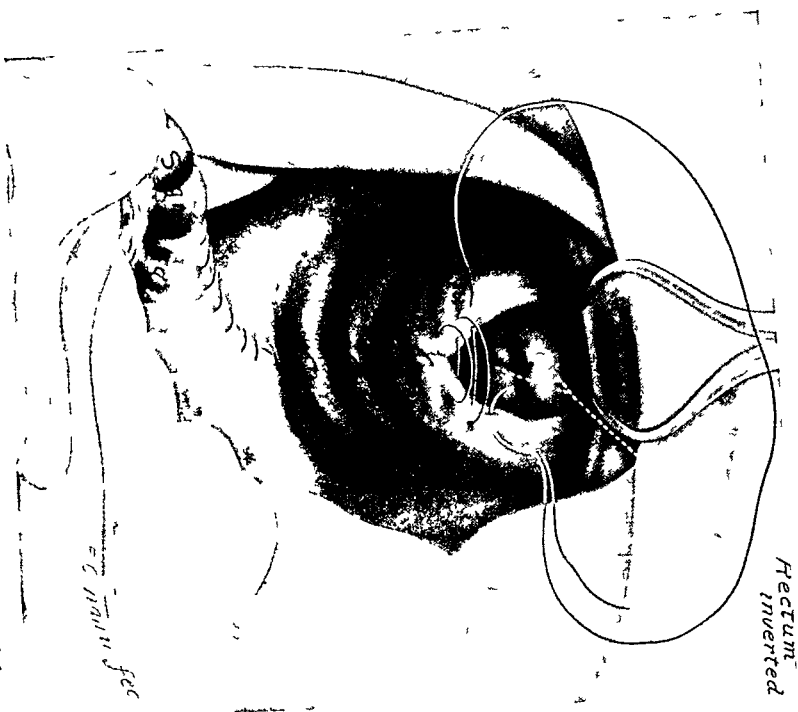


FIG 4.—After the distal sigmoid has been inverted and drawn out through the anus the inverted end is closed by three or four interrupted catgut sutures and a continuous catgut suture is run along the mesosigmoid covering the raw surface with peritoneum from the proximal sigmoid to the bottom of the cul de sac.

should not have been attempted. This was the only death in the eight cases by this method. This method is certainly less shocking than any other that we have tried, and is particularly applicable to cancers of the rectum proper, even those cases involving the sphincter. The operation of course is not applicable in cases of total obstruction.

The second stage of the operation is particularly suited to spinal anæsthesia or to gas anæsthesia.

a radius of one or even several inches In a case in which the tumor lay in the subcutaneous tissues over the patella, it could be moved over the entire patella

Such tumors are found in women far more frequently than in men Neuromata, with which painful subcutaneous tubercles are often confused, are found more often in men Paget⁶ gives the following table of statistics in 26 cases of neuroma, 19 were in men and 7 in women, whereas, in 28 cases of painful subcutaneous tubercle, 23 were in women and 5 in men It usually occurs singly, although W Wood⁷ reported a case in which three of these tumors were removed from the tissues overlying the glutæus maximus muscle

It is either round or oval in shape, and usually about the size of a pea, though it may be somewhat larger In consistency, it is very firm and it feels elastic when rolled between the fingers According to Caruthers,⁸ the tumor occasionally has a central cavity filled with fluid In only one case reported, which will be mentioned later, has there been any tendency to ulcerate or break down

Of the *symptoms*, the most characteristic is the pain which is radiating and neuralgic in type This pain is greatly increased when the tumor is palpated, as the tumor itself is exquisitely tender, in fact, the tenderness is so marked that the patient is usually very apprehensive about the handling of the region The patient from whom I removed such a tubercle from above the patella was not only afraid to kneel down because of pain, but, for several weeks prior to the operation, had been so apprehensive of pain, that she walked with her knee stiff, fearing to bend the joint The tubercle when removed was round, very firm and no larger than a pea

The pain is not usually continuous, but occurs in paroxysms These paroxysms may last for many hours if the tumor has received a blow If such a tumor on an arm or leg receive a blow, the extremity may be thrown into a clonic convulsion The patient may fall because of pain, and not infrequently faints if the tumor is struck The pain is often exaggerated during mental emotion, especially during the menstrual period In the exceptional case, if the tumor has received a blow, the surrounding parts may become cedematous, simulating angioneurotic cedema

The *structure* of these tumors appears still to be somewhat in doubt, they are now usually classified under "neurofibroma"

Velpeau⁹ believed them to be neuromata of subcutaneous nerves This theory is held by others In the *American Text-book of Surgery*,¹⁰ we find the statement,

ported wherein the tumor became malignant. This was a case of painful subcutaneous tubercle reported by Dupuytren,² in which the tubercle acquired a schirous nature and underwent cancerous softening.

The painful subcutaneous tumor may be diagnosed from a neuroma, by the fact that the former is usually single, whereas the latter is more often multiple, the former occurs more frequently in women, the latter in men, the former grow slowly, some attain full growth and remain stationary, and never attain any considerable size, whereas the latter grow consistently and have no limit to their size.

The treatment of the painful subcutaneous tubercle consists in excision. The authors of the *American Text-book of Surgery*,²³ in speaking of treatment, say "the treatment is excision of the tumor together with the portion of nerve twig in which it grows." It is not always possible, however, to find such a twig. Gross,²⁴ in summing up the treatment, says there should be "free excision, including a portion of the surrounding healthy integument."

The tubercle can be removed under local anæsthesia. In those which I have removed, however, I used nitrous oxide gas, because of the fact that the tubercles usually occur in the nervous type of women, and because the tubercles were so small that I feared they would be hard to find after infiltrating with a local anæsthetic. Because of the fact that the tubercle is often so small and movable, it is well to fix it with a needle before making the incision so that it may be readily found. Cases have been reported in which the tubercle recurred after removal. Sir Astley Cooper²⁵ reported such a case in which he removed two painful subcutaneous tubercles from a woman's leg at an interval of a year. Similar cases have been reported by Paget and Tait.

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- ² Gross. *System of Surgery*, vol 1, p 235, and vol 11, p 1017
- ³ Brodie. *Med Gazette*, vol xxi, p 926
- ⁴ Smith. *Treatise on Neuroma*
- ⁵ Paget. *Lectures on Surgical Pathology*, p 487
- ⁶ Paget. *Ibid*
- ⁷ Wood. *Ibid*
- ⁸ Carruthers. *Edinburgh Med and Surg Jour*, vol xxxiii
- ⁹ *Médecine Opératoire*, vol iii, p 101
- ¹⁰ *American Text-Book of Surgery*, p 412
- ¹¹ Keen. *Keen's Surgery*, vol 1, p 761
- ¹² Gross. *System of Surgery*, vol 1, p 1017
- ¹³ Treves' *Surgery*, vol 1, p 458
- ¹⁴ DaCosta. *Modern Surgery*, 1914, p 355

TYPHOID SPINE

organic changes should henceforth be excluded from the list of true typhoid spine cases. The fact that the skiagram has been negative in a few cases does not in itself disprove the presence of an organic lesion, the bone changes may have been too slight to be demonstrable or the pictures were either faulty, or, when taken early in the course of the disease, were negative, when later ones might have shown bone changes, as in my third case.

The statistics on the reported cases of typhoid spine have been collected and analyzed by Cutler, Silver, Halpenny, Rogers, Gaudefroy, Elkin and Halpenny, and others. It has been found that fully 85 per cent of the cases occur in males. The youngest patient was eight years and the oldest fifty-six years, but the majority were between twenty and thirty-five years.

Typhoid spine occurs as commonly in mild cases of typhoid fever as in severe ones. In the vast majority of instances the affection is located in the lumbar spine or in it and the immediately adjacent thoracic or sacral vertebræ, although it has been reported affecting only the thoracic or cervical vertebræ, or, as in a case reported to this Society by Dr Elmer, involving only the sacro-iliac joint. Commonly only two adjacent vertebræ are involved, though, rarely, several may be.

Pathology—That the affection is located so commonly in the lumbar spine is due to various factors. Fraenkel found typhoid bacilli more frequently in the vertebræ of the lumbar region than elsewhere, due probably to the relatively larger amount of bone marrow in them. The lumbar spine is also normally subjected to greater stress and strains than is the remainder of the spinal column. Silver has further suggested that, in addition to the greater amount of cancellous tissue offering low resistance to the typhoid bacilli, there is the possibility of direct infection from the adjacent lumbar lymph-nodes. Typhoid spine is almost never a fatal affection, hence post-mortem study of recent cases is wanting.

The clinical evidence points to the lesion being a spondylitis with periostitis, enchondritis and deposit of inflammatory exudate. The X-ray has demonstrated absorption of the intervertebral disc and slight destructive changes in the bodies of the vertebræ as the earlier changes, and later, bone proliferation from the periosteum and bone deposition along the lateral ligaments producing firm bony ankylosis of the approximated adjacent vertebral bodies.

The infrequency of suppuration in the vertebræ as compared to typhoid lesions in other bones has never been satisfactorily explained.

The cause of referred pains and rhythmical contractions is some-

TYPHOID SPINE*

WITH REPORT OF FOUR CASES

By J B CARNETT, M D

OF PHILADELPHIA

ASSOCIATE IN SURGERY, UNIVERSITY OF PENNSYLVANIA, ASSISTANT SURGEON TO UNIVERSITY OF PENNSYLVANIA HOSPITAL, SURGEON TO THE PHILADELPHIA GENERAL AND THE AMERICAN STOMACH HOSPITALS

OVER one hundred cases of typhoid spine have been reported since the publication of the first paper calling attention to this condition by Gibney in 1889. Gibney expressed the opinion that in typhoid spine there is "an acute inflammation of the periosteum and the fibrous structures which hold the spine together." The next important paper on this subject, a few years later, was by Osler, who, unfortunately, in reporting some of his own cases described the condition as a pure neurosis. The pathology of typhoid spine has been the subject of much theoretical discussion along the lines of the divergent views expressed by Gibney and Osler.

The only reported autopsy examination was not performed with sufficient detail to throw much light on the lesions present. The only complete post-mortem study of which I have any knowledge is that made by J. Torrance Rugh in a case some years after the disappearance of the acute symptoms.

The earlier cases of typhoid spine were observed before the days of the X-ray or before X-ray technic had developed sufficiently to demonstrate the spinal lesions. Even in many of the recently reported cases skiagrams were not taken. Thus far, less than 30 cases of typhoid spine have been reported in which X-ray pictures were taken and in some of these the skiagrams were negative. To this list I have added three personal cases in which the X-ray disclosed definite bone changes. Sufficient evidence has been accumulated to prove definitely that Gibney was correct in his original view that an inflammatory organic lesion does occur in these cases.

That a pure neurosis might possibly simulate, to a certain extent, the true inflammatory organic lesion of typhoid spine just as it might simulate any other organic lesion cannot be denied, but in view of our present knowledge of the subject such confusion should not occur. In other words, those cases which only simulate typhoid spine, whether because of a neurosis, a toxæmia, or any other cause, but which do not present

* Read before the Philadelphia Academy of Surgery, December 7, 1914.

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Great mental irritability has been noted in several instances, due probably to weakness from prolonged illness, present toxæmia, and harassing pain. A few patients threatened to commit suicide. This irritability in its various manifestations has been one of the main arguments in the past for regarding typhoid spine as a neurosis. As one writer has pointed out, if these patients with their painful organic lesions are treated as cases of neurosis, ordered out of bed, placed on exercises, etc., it might reasonably be expected that they would display "neurotic" symptoms.

Local or Spinal Symptoms—Pain over the spine has been the most constant and prominent symptom, as well as usually the first to attract attention. The local pain, however, has sometimes been overshadowed by the greater intensity of the referred pains. Local pain over the site of the disease has usually been absent when the patient was at complete rest in bed, but was elicited by movements of the spine, whether by turning in bed or tests applied in making an examination. Downward push on the head or shoulders, jarring on the heels and efforts at bending or twisting the spine have aggravated this pain. The patients have protected themselves against exciting the pain, in the manner characteristic of cases of acute inflammatory lesions of the spine, by transferring weight through their arms and hands to their pelvis, thighs, bed, or chair, and picking articles from the floor by flexing the knees and hips rather than bending the spine. The pain has disappeared during the subsiding stage for days or weeks to recur on resumption of active exercise or labor.

Tenderness was elicited either over the spinous processes in the median line, or over the transverse processes in all cases. In some tenderness over the anterior surface of the bodies of the vertebrae could be elicited by deep abdominal palpation.

The spine in the affected region was stiff and spinal muscles were rigid in practically all cases. In some scoliosis was present, in others the normal lumbar lordosis was lost, and in a small percentage a vertebral prominence or definite kyphosis developed in the later stages. In but very few cases was there local swelling or redness. In only three or four cases did the disease result in suppuration requiring incision and drainage.

At the present day the X-ray in the later stages of the disease affords the best proof of the existence of a local spine lesion. In this connection I cannot commend too highly the method, which is not in general use, employed by Dr. Henry K. Paracoast of taking

what problematical. They may be due to neuritis from extension of the inflammation and this seems suggested by evidence of organic nerve lesions in some cases. Again they may result from meningitis. Positive Kernig's sign has been noted but only rarely. Lumbar puncture has shown the tension of the spinal fluid increased in a few instances and normal in others. Pressure on the spinal nerves or nerve roots by inflammatory exudate seems the most probable cause. Those cases in which there are alternations of the referred pains and rhythmic muscular spasms suggest that whatever irritation is present in those cases must be located at some point where the motor and sensory fibres are separated one from the other. This would imply an exudate exerting pressure on the anterior and posterior spinal nerve roots proximal to their passage through the intervertebral foramina. The rhythmic contractions being synchronous with the pulse, would indicate they were due to pressure which would alternately be increased and decreased as the blood was forced through the pressure area.

The onset of symptoms was usually gradual, but in many was abrupt and acute, occurring in a few cases during the febrile period, most often during convalescence, and quite frequently some weeks or months, in one case four years, after recovery from typhoid fever.

There seems no doubt that the typhoid bacillus is the cause of the lesion. The presence of typhoid bacilli in bone marrow, especially of the spine, in patients dying of typhoid fever has been shown by Quincke and by Fraenkel.

Various forms of slight trauma or exposure to wet and cold were given as the immediate cause for the onset in many cases. It is quite probable, however, that the spinal lesion was already present and that the trauma merely aggravated it or first called attention to its existence. This would seem to be the case in those patients in whom acute symptoms developed within a few hours after receipt of the trauma.

The symptoms of typhoid spine can be classified as (1) constitutional, (2) local or spinal, and (3) referred.

Constitutional Symptoms—The patient's temperature in one case was normal, but in all others reported in which the temperature was given it was elevated, seldom reaching 103° or 104° F, but in one of my patients going to 106° F in the first twelve hours. Fever usually subsided in a few weeks and persisted only two months in the longest instance recorded. The pulse-rate increased with the fever. The Widal tests, when taken, have been positive. Leucocyte counts have not been reported very frequently and have varied from 6000 to less than 18,000.

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which it is mentioned, was normal in a few, and rarely was diminished. Ankle-clonus was observed in several cases and Kernig's sign rarely. Hyperæsthesia or paræsthesia of areas on back, abdomen or lower extremities was noted in several cases and not found in others. Muscular atrophy sufficient to indicate nerve lesion occurred infrequently.

Diagnosis—The diagnosis of typhoid spine usually should not be difficult. The existence or recent history of typhoid fever, the characteristic localized acute spinal symptoms, the suggestive referred symptoms, the constitutional disturbances, and later the X-ray findings afford an unmistakable picture in the typical cases. Difficulty as to the diagnosis, however, may arise under certain circumstances. Not all pains in the back of typhoid patients are due to typhoid spine. Doubt may arise as to whether or not early symptoms in a given case are due to the gradual onset of a typhoid spine or due to some of the more common but less serious forms of backache. Continued observation and study of the further course of the affection will soon disclose the correct answer to the question.

In cases of acute onset with predominance of the referred symptoms, the local symptoms in the spine itself may easily escape observation, unless the possibility of typhoid spine is kept in mind and these local signs are sought for. If the possibility of a spine lesion is not given proper consideration then various erroneous diagnoses may be made. The constitutional symptoms of fever, pulse-hurry and leucocytosis, plus the referred symptoms of pain, tenderness and rigidity of sudden onset present a fairly complete picture of any of the forms of intra-abdominal inflammation or suppuration.

The particular lesion which the typhoid spine will simulate under such circumstances is dependent on the abdominal region to which the symptoms of pain, tenderness and rigidity are referred. In such circumstances, however, it may be found that some special symptom of the disease under consideration is wanting, that the local signs are a little too diffuse or that there are other inconsistencies in the picture or course of the affection viewed as a whole. But even then the picture so closely simulates the conditions for which immediate operation is indicated that, unless the possibility of spinal lesion is considered, the patient is apt to be subjected to a needless laparotomy.

Again, the presence of mild spinal symptoms may be recognized and yet the constitutional disturbance plus the referred symptoms and their location be so very characteristic of an intra-abdominal lesion that two erroneous possibilities present themselves—either that a spinal and an abdominal lesion exist independently of one another or that an

lateral views of the spine to bring out details unobtainable by the usual anteroposterior exposures.

Referred Symptoms—Aside from the purely local pain in the spine the great majority of typhoid patients experienced severe or even excruciating pains radiating in one or more directions, as around one or both sides of the lower chest or abdomen, down one or both lower extremities, and into the testis. The referred pains were usually intermittent in character and very often were most violent and persistent at night, requiring opiates to procure sleep. The referred pains might persist from a few minutes to several hours at a time and then cease and recur after minutes or hours. These pains were commonly brought on or aggravated by any movement involving a strain on the spine, as turning in bed, lifting a leg, coughing, sneezing, etc. In a few cases the hot-water bottle was efficacious in controlling the pains. Complete fixation of the spine by a body plaster cast, spinal brace or extension apparatus usually gave prompt and marked relief.

Quite frequently tenderness was present over the same areas as the pain radiations. Occasionally muscular rigidity of an intensity which varied on different days, or even at different hours of the same day, was encountered in those cases in which pain was referred to the abdomen.

A few cases of typhoid spine have exhibited a curious rhythmical alternating contraction and relaxation of the abdominal muscles on one or both sides. These contractions usually have been synchronous with the pulse beat, and in one reported case they could be abolished by compression of the upper abdominal aorta. The contractions have arisen spontaneously with the patient at complete rest in bed, or have been started up by movements affecting the spine. They would occur rhythmically for a few moments up to three or four hours, and cease only to recur later. The individual contractions have been mild at one time and violent at another, or might start mildly and become vigorous, giving rise to discomfort varying from slight annoyance to great distress, and leaving the muscles sore, as if violently over-exercised, after the contractions cease. The contractions have occurred at intervals during which the referred pains might be either present or absent. The contractions as well as referred pain might be present on one side of the abdomen at a certain stage of the disease and on the other side at another stage. Rhythmical contractions of abdominal muscles were present in two of my patients. In one reported case muscular twitching of the thigh was noted.

The patellar reflex was increased in the majority of instances in

TYPHOID SPINE

for one month, when it stopped and pain shifted back to right sciatic for the next month. During all this time remained in bed. Had pain in lower back, made worse by movements.

Through the kindness of Dr. George H. Parker and Dr. MacKenzie I saw the patient at his home in April, 1908, at which time he complained of pain in the back and in the right sciatic distribution, both of which were aggravated by spinal movements. Right sciatic nerve was tender to the touch. Normal lumbar curve was lost. Spine was rigid. Tenderness most marked in mid-lumbar region. Made a diagnosis of typhoid spine. A plaster cast was applied by suspension method the following day, with 50 per cent betterment in the pain within the next few days, and at end of two weeks pain had almost completely left. By end of third week cast had softened and was removed. Pain recurred in mild form. Cast reapplied for another three weeks, after which patient got up from bed and gradually resumed his activities.

His only skiagrams were taken on December 3, 1914, nearly seven years after the onset of his typhoid spine. X-rays show complete absorption of the disc between the second and third lumbar vertebræ with ankylosis between these two vertebræ. There is a slight kyphosis in this region.

He still continues to have occasional pain in form of backache, never severe and never interferes with whatever he is doing.

CASE II—J. M. A., male, twenty years of age. Painter by occupation. Indulges freely in athletic sports, musculature well developed. Normal weight 138 pounds. Height 5 feet 6 inches. Previous medical history negative. Had mild attack of typhoid fever beginning October 6, 1907. Normal course till November 1, when he developed right femoral phlebitis. Christmas day sat up out of bed for first time. Gradual resumption of activity. During the last week of January, 1908, fell on ice while skating, but experienced no ill effects at the time. On the following day experienced a sudden severe pain in the back on attempting to rise from a stooping position. Pain continued in less severe form till February 3, when it extended to the right side of the abdomen. The patient was then confined to bed and treated for lumbago. About this time there was an almost total suppression of urine. Only three ounces of urine were obtained by catheterization after a period of 20 hours. Urine highly acid, specific gravity 1028, no sugar, no albumen. Complained of slight headache and aching pain in the back of neck. Mind slightly confused and later marked delirium. The temperature taken infrequently was subnormal until February 16, when it was 102.4° F. Thereafter was subnormal mornings and elevated in afternoons but gradually subsiding.

abdominal suppuration occurred first and the spinal symptoms arose secondary to a toxæmia, metastasis or direct extension from a retro-peritoneal infection. If the diagnosis is uncertain under such circumstances it will usually be wise for the surgeon to delay operation until reasonably certain of the situation. The X-ray cannot be depended upon when the early pictures are negative, as it may require weeks for bone changes to develop to the extent that they can be shown by skiagraphs.

Prognosis as to life seems entirely favorable as none of the patients died of the typhoid spine lesion. Suppuration to the extent of requiring evacuation has been very rare. It is possible that small foci of pus might form and be absorbed. Absorption of one intervertebral disc with osseous ankylosis of the two adjacent vertebræ may be expected. Occasionally changes of the same type have involved more than two vertebræ. Kyphosis may or may not develop, or, as pointed out by Silver, may be present and obscured by heavy overlying muscles. By proper support of the spine until ankylosis occurs kyphosis can be prevented. A relapse to the extent of return of pain and tenderness is not uncommon during the subsiding stage from too early resumption of activity, but, unlike inflammatory spinal affections, typhoid spine, once arrested, does not tend to recur. Symptoms disappear in a few weeks or months, as a rule, but in Brownlee's case they persisted for 21 months. The ultimate functional result is usually perfect. If only two vertebræ are ankylosed the adjacent joints apparently are able to compensate for the lost mobility.

Treatment—The best form of treatment is mechanical. The spine should be placed at as near absolute rest as possible. This may be accomplished by either plaster-of-Paris cast, spinal brace, or by continuous traction from head and feet. Pain often has ceased abruptly after fixation of the spine. Excessive pain can be relieved by the local application of heat, by aspirin or sedatives, but often opiates will be needed. Elimination should be pushed to combat the toxæmia. In prolonged cases vaccines may be of service.

CASE I—M. B. M., male, aged fifteen years. Patient of Dr. T. H. Mackenzie of Trenton, N. J. After a week of prodromal symptoms patient went to bed the day following Thanksgiving, 1907. High fever, up to 104° F., for two weeks, constipation, tympanitis and rose spots. Three or four days after first getting out of bed in February, 1908, was hit with a severe pain in the back and along the right sciatic nerve. Following day pain shifted from right to the left sciatic nerve distribution and continued there

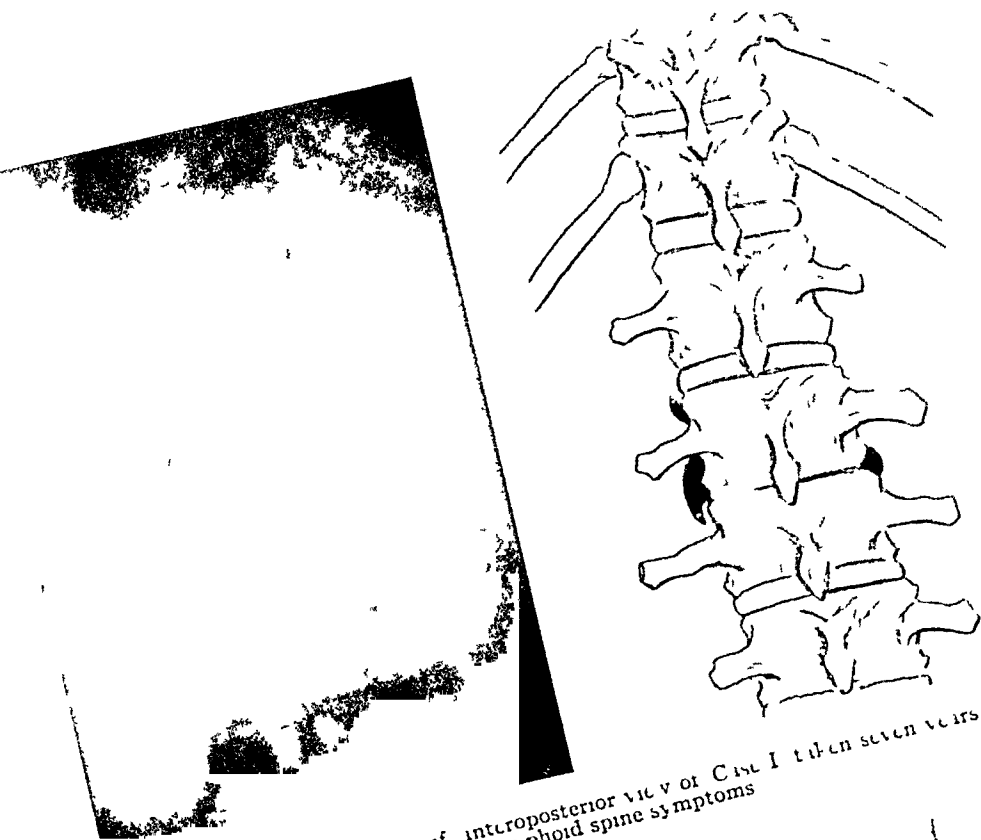


FIG 1—Skiagraph and diagram of interposterior view of Case I taken seven years after onset of typhoid spine symptoms

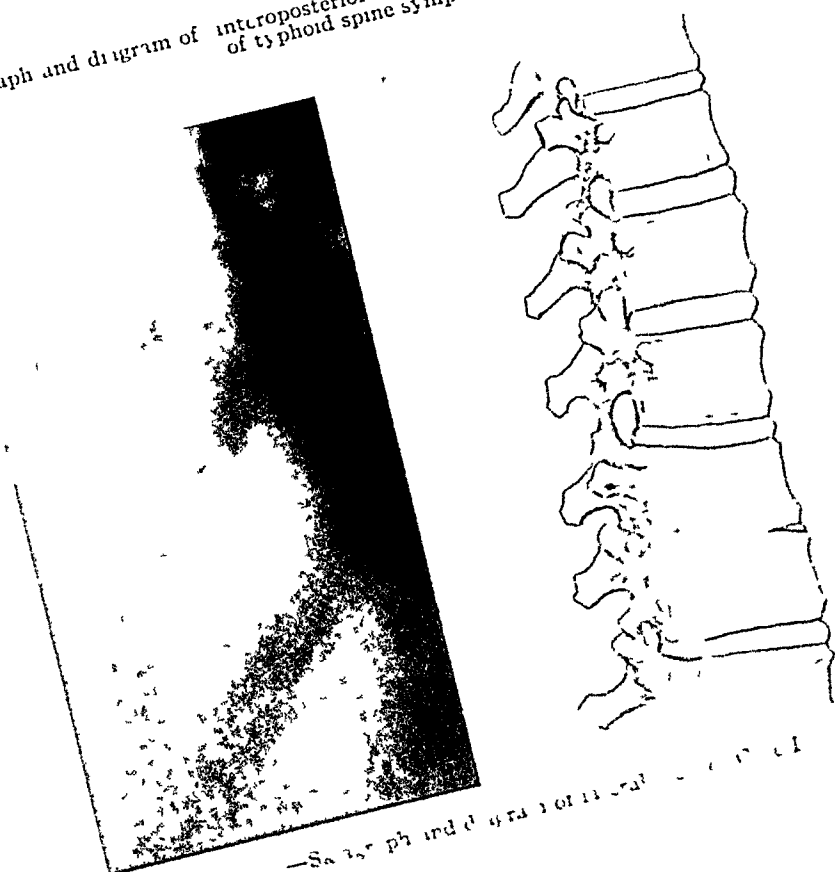


FIG 2—Skiagraph and diagram of Case II taken seven years after onset of typhoid spine symptoms

for next eight days, after which it remained normal and sub-normal Profuse sweating occurred during febrile period

On February 10, patient began to have what he described as rhythmic "pulsations of the abdomen" These pulsations were slight at first and had a duration of only five or ten minutes, later on becoming more violent and persisting without intermission for hours

The patient was examined at this stage by his brother, a physician, who observed that all of the abdominal muscles participated in violent, painful rhythmic contraction and relaxation, always at the rate of 104 or 106 to the minute, and not synchronous with the pulse These convulsive abdominal movements would persist for upwards of six hours at a time and then cease, but on patient getting out of bed would recur in all their intensity, and were accompanied by pain at each contraction The only relief obtainable was by having some one stand over him and press down heavily with flat hands on his abdomen The contractions were so forcible that they almost lifted the entire weight of his heavy brother The manual pressure would not cause contractions to cease but made them bearable After contractions had ceased any attempt to relieve pressure immediately was followed by recurrence of contractions, but after waiting a few minutes pressure could be gradually released without recurrence

The brother came to Philadelphia February 21, seeking advice, and the diagnosis of typhoid spine was suggested to him He returned to the patient with the expectation of applying a plaster cast and bringing him to this city On the night of February 21, the muscular spasms were the most violent they had been at any time and persisted without remission all night long, then ceased abruptly and patient slept continuously for 36 hours thereafter and remained drowsy and stupid for several days without contractions or pain On March 6, following a trip to the toilet, mild contractions and pain recurred for a few minutes It was noted that the normal lumbar lordosis was lost and that spine was straight for 14 inches

On March 10 there were noted feeble contractions on the left side with pain and a "sore spot" in left iliac region

On March 12, 1908, he entered the University of Pennsylvania Hospital He was 20 pounds under weight Complained of slight pain in left flank when he began to move about, but pain ceased on further movements Abdomen was slightly rigid anteriorly and laterally on left side, some rigidity of spine and loss of normal lumbar curve but no kyphosis There was a point of tenderness on deep pressure posteriorly at the side of the last dorsal vertebra Reflexes normal

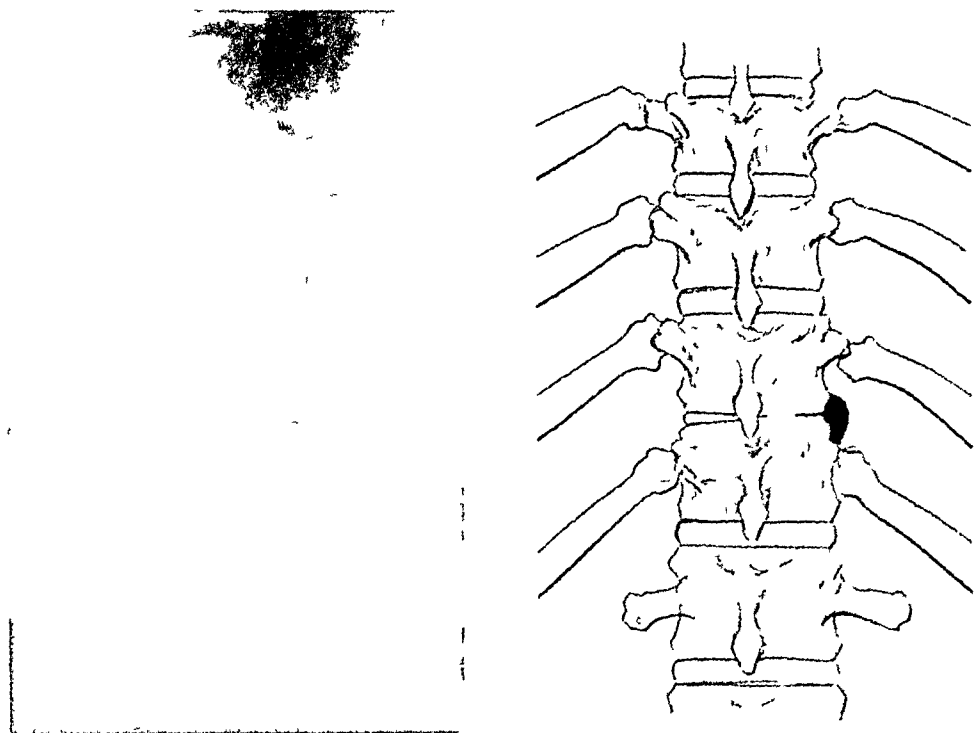


FIG 5 —Skiagraph and diagram of anteroposterior view of Case III, six months after onset of symptoms

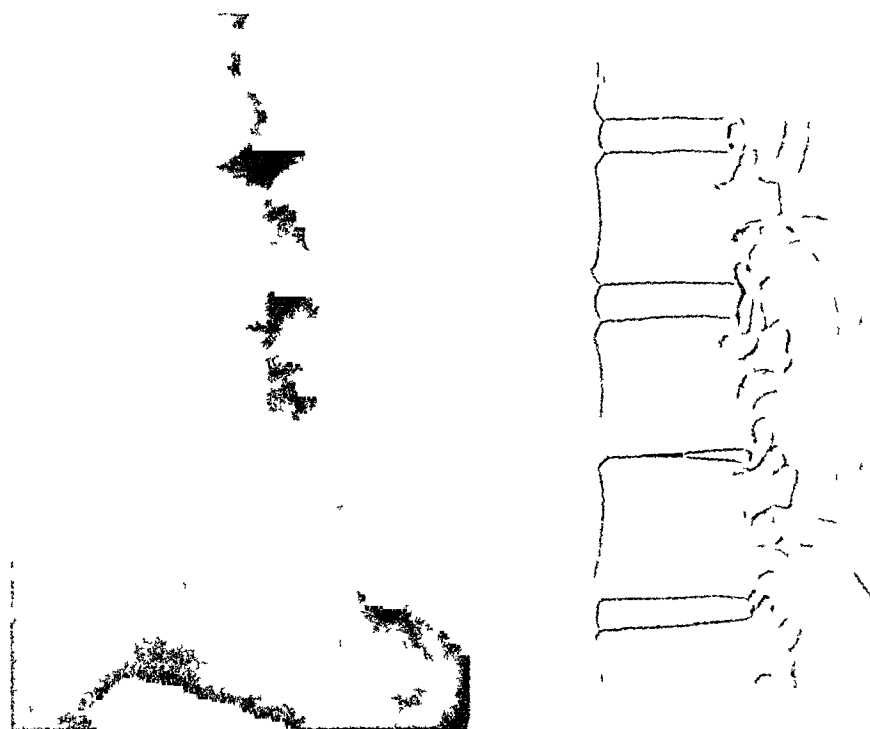


FIG 6 —Skiagraph and diagram of lateral view of Case III

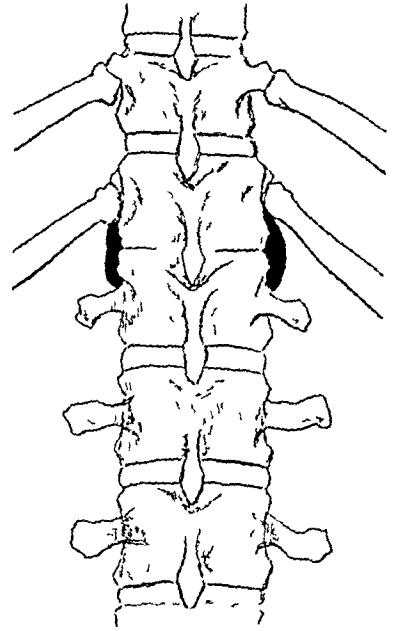
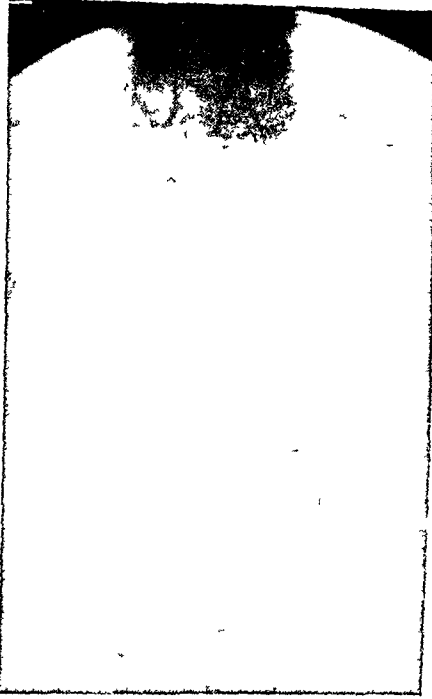


FIG 3 —Skiagraph and diagram of anteroposterior view of Case II taken seven years after onset of symptoms

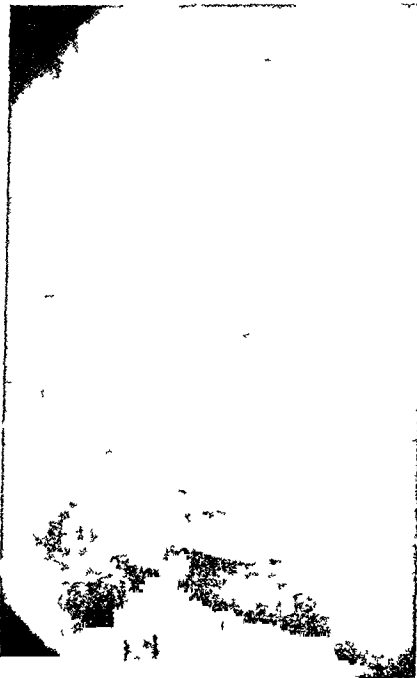


FIG 4 —Skiagraph and diagram of lateral view of Case II

TYPHOID SPINE

Skagrams taken on March 15 disclosed a small area of osteoporosis of last thoracic vertebra and small amount of bone proliferation on the left side of body of same vertebra X-ray pictures of the spine in those days were not very clear cut and the exact details of lesion were uncertain Patient left hospital the following day without notice

I next saw him November 26, 1914 He stated that he had no further trouble after leaving the hospital and was soon able to get about freely and in a couple of months returned to his occupation of painting railroad cars

In the fall of 1908 he practised cross-country running of 7 and 8 miles daily with fellow-members of a club, and the same fall, and yearly since then, has played regularly on a foot-ball team Although a small-sized man he is able to lift a 100-pound weight above his head with one hand He has not experienced any difficulty whatsoever from his spinal lesion

On examination his spine has normal outlines, is supple, and gives no evidence of kyphosis The X-ray, however, November 26, shows complete absorption of the intervertebral disc between the last thoracic and first lumbar vertebræ, with approximation of these two vertebræ and complete bony union along their lateral ligaments

CASE III—J W C, male, aged twenty-nine Professional base-ball pitcher Four years ago mild catarrhal jaundice for ten days Eight months ago mild attack of pleurisy, uncertain as to which side of chest Venereal history negative

March 20 to 24, 1913, violent gastro-intestinal disturbance, at Birmingham, Alabama, following ingestion of tainted food, with gradual recovery

April 10, 1913, while in Boston, began to feel generally miserable and developed fever, because of which he returned to Philadelphia, his home city Widal reaction negative weekly for four weeks, and then positive, at which latter time rose spots first appeared and were numerous for few days, then disappeared, mild abdominal tympany Spleen not palpably enlarged. Temperature up to 102° and 103° F

On May 10 temperature, having been around 99° for four days, abruptly rose to 103° coincident with onset of pain and tenderness over gall-bladder, no jaundice. Fever continued at 101° to 103° for ten days, then gradually declined, but some soreness persisted over gall-bladder

On June 10, sufficiently recovered to go to Atlantic City June 25, went to Maine Soreness still present in biliary region Applied a fly blister, and soreness ceased August 1, rejoined his

TYPHOID SPINE

trivial in comparison to the referred pain in the upper abdomen that it was only with extreme difficulty that this intelligent patient could be convinced that the trouble was in the spine and not within the abdomen. A diagnosis of typhoid spine was made and the patient was sent to the University of Pennsylvania Hospital. Radiographs of the spine taken the following day (September 13) and on September 14 and 16 failed to show any abnormalities. He was kept at rest in bed. Pain was most marked at night and apparently was relieved somewhat by a hot-water bottle. On September 16 a plaster cast was applied from axillæ to the hips without relief of pain. Aspirin and bromides had no effect. Morphia was required for sleep. Three days of the cast had no effect on the pain, and in response to the patient's urging it was removed to enable him to reapply the hot-water bottle which he would place over the lateral wall of the abdomen and chest rather than over the spine. The urine repeatedly exhibited a trace of albumen, many hyaline and granular casts, an occasional red blood-cell, and great excess of leucocytes, but by October 1 the red cells and excessive leucocytes had disappeared from the 24-hour specimen. Examination of the blood showed 4,470,000 red cells, 9900 leucocytes and 80 per cent hæmoglobin. The differential count gave 56 per cent polymorphonuclears, 31 per cent lymphocytes, 7 per cent large mononuclears, 4 per cent transitionals, and 1 per cent eosinophiles.

On repeated leucocyte counts the highest number obtained was 11,100 on October 3. Widal test (September 27) was positive, Wassermann (September 25) and Von Pirquet (October 1) tests were negative. Blood cultures (October 3) were sterile. From a culture of the fæces (October 1 and October 10) a paratyphoid organism and non-motile, rod-like bacteria of the *aërogenes* type were isolated. Urine was examined bacteriologically but report has been lost. Nothing very suggestive was found.

His temperature the first five days after admission to the hospital varied daily between 98° and 99°, then showed an upward trend and for twelve days ranged chiefly between 99° and 101°, going down occasionally to 97.6° and up to 102°. On October 1, the day extension was applied to head and neck, the temperature reached 102°. The following day it did not go above 99.6°, and thereafter continued lower, being entirely normal or subnormal during his last month in the hospital.

On September 20 and November 22, 1913, exhaustive general examinations from the neurological stand-point were made by Dr. Wm G Spiller. The only deviation from the normal he could discover was a diminution in the intensity and promptness of the

team in Philadelphia against his physician's advice, went on western trip and gradually resumed active exercise

September 1, while swinging bat at a pitched ball, was seized with violent pain over the lower ribs on the right side. Rested for several minutes, then was able to bat balls to the infield, although it caused him considerable pain. After going to bed that night pain recurred with increased severity and he developed a temperature of 106° F with delirium. Pain increased by deep breathing but no friction sounds audible. Strapping of chest gave marked relief. Was ordered general sponge baths and colonic irrigations. Following day temperature $104-105^{\circ}$, then returned to near the normal in five or six days. Pain located at right costovertebral angle continued in lessening severity, and was made worse by motion such as turning in bed, rigidity and tenderness of upper right abdomen. His symptoms were suggestive of possible diaphragmatic pleurisy, or of infection in gall-bladder, liver or kidney, or in subdiaphragmatic or perirenal regions.

I saw the patient for the first time on September 12. Temperature was then 99.6° , pulse 90, and respiration 20. He complained of pain in upper right abdomen. Pain was most severe at night, when it would persist for hours, preventing sleep, but would disappear during day while at complete rest in bed, only to reappear on motion, as getting out of bed or turning in bed, and had diffuse tenderness over upper right anterior and lateral abdomen and hepatic area. Most marked point of tenderness was at right costovertebral angle. Lungs and pleura showed no abnormalities, deep inspiration no longer painful, reflexes normal. On sitting up in bed pain was increased and he supported his weight by his hands in the way characteristic of acute spinal cases. Being asked to raise his hands said he could not do so, as back felt "too weak" to sit up unsupported. Spinal muscles were tense on both sides and the dorsolumbar spine was rigid. Tenderness over last dorsal and first lumbar vertebræ was slight in the median line but more marked over right transverse processes of same vertebræ. Reflexes were normal. On standing erect he supported his body weight by his hands placed on pelvis. On attempting to pick up an object from the floor he kept spine rigid and flexed the hips and knees in the same way as a case of acute Pott's disease. Downward pressure on head or shoulders evoked complaints of increased abdominal pain. He was returned to bed when it was observed that he had slight rhythmical alternating contraction and relaxation of his upper right abdominal muscles for the next two or three minutes, and pain was so aggravated by the various manipulations that it persisted in severe form for a full hour. Curiously enough the local pain in the spine was so

TYPHOID SPINE

sidered frequently, as to whether or not there was an intra-abdominal or retroperitoneal abscess. The history of two previous attacks of biliary trouble, the preceding urinary findings, and the negative X-rays at this late stage of the spinal disease, all contributed to the difficulty of the situation. The right-sided symptoms, however, suddenly ceased and a day or two later mild pain, tenderness, rigidity and muscular spasms appeared on the left side for the first time. The left-sided symptoms were never severe and disappeared in a few days.

On November 5 was measured for a spinal brace, but to enable him to sit up in bed at once a plaster cast was applied. The cast proved uncomfortable and sitting up in it caused mild recurrence of right-sided pain and twitching, and it was removed on November 8. Thereafter no pain except when he turned in bed. November 15, the spinal brace applied. November 18, X-rays for first time demonstrated slight changes in the form of absorption and new bone deposit along the edges and sides of the bodies of the eleventh and twelfth thoracic vertebræ. On November 26, out of bed for first time, and on November 28 left the hospital, being then able to walk with difficulty, owing to muscular weakness. An X-ray taken December 17 showed narrowing of intervertebral space and more bone deposit. He continued to wear the spinal brace till February, 1914, when parts of it were removed, and a month later began leaving brace off part of each day, finally abandoning it altogether about May 15. In July he began light exercise and at end of August was given permission to go the limit in exercise. He was not able to regain his old-time form as a pitcher before the end of the season, but this seems more likely to have been due to his not having pitched for two seasons, during which he passed through two prolonged illnesses, rather than to any difficulty existent in the spine. He could pitch fast balls satisfactorily but did not have the usual control over his curves. As he described the situation, his pitching was of his usual calibre at the beginning of previous seasons, and with more practice he felt he would regain control as he had in previous years as the season progressed.

His last X-ray was taken on March 17, 1914, and shows absorption of the intervertebral disc with ankylosis of the eleventh and twelfth thoracic vertebræ. He had no kyphosis, no pain nor tenderness and no apparent limitation of spinal movement when last examined in August, 1914.

CASE IV—J. H., male, thirty-seven years of age, Belgian; sailor. Admitted to service of Dr. Alfred Stengel at University of Pennsylvania Hospital on September 5, 1914. Had been ill for six days. On admission, tongue coated, spleen uncertainly palpa-

right upper abdominal (epigastric) reflex at the first examination, but this defect was barely noticeable at the second

Beginning on September 17 and continued daily thereafter for two weeks, colonic irrigations of from two to three quarts of normal saline solution were employed at the suggestion of Dr Alfred Stengel, who had observed following this treatment prompt cessation of symptoms in a number of similar post-typhoidal cases. The irrigations seemed especially appropriate in this case because of a year's long constipated tendency, but they had no beneficial effect on symptoms and were discontinued because the manipulations attending their administration and expulsion aggravated the pain. Thereafter the constipation was corrected by paraffin oil aided by various laxatives.

From the time the patient entered the hospital he continued to have intermittent pain and intermittent rhythmical spasms of the muscles on the right side of the abdomen. The pain and rhythmical spasms might occur together or independently of one another, and either or both would be excited by movements in bed. When either or both were present they might persist for a few minutes only, or for hours at a time. Pain was particularly severe for hours continuously almost every night, partially relieved by hot-water bottle, but sleep often not obtained by anything short of opiates. The rhythmical spasms were synchronous with the pulse, were observed chiefly on the right side, and then would pull linea alba to the right. After cessation of a long continuance of the spasms the muscles would be sore as after vigorous exercise in one unaccustomed to it. Adhesive strapping and tight circular bandaging of the abdomen, applied during times cast was off, somewhat relieved the distress of the rhythmic contractions but did not stop them. During the intervals free from rhythmic contractions the muscles of the upper right abdomen were more or less rigid. Efforts at deep palpation excited an increase in the rigidity.

On September 26, X-rays were negative. Plaster cast was applied that day, but with no relief, and was removed two days later. Cast reapplied morning of September 30, under different conditions from former ones, but pain being made worse it was removed in the evening of the same day. On October 1, obtained a longer bed for patient and applied extension to head and legs, which was continued until November 5. This was promptly followed by relief of pain and spasms, and after two days they both ceased entirely for several days. On October 15 X-rays were negative. About this time a recurrence of marked pain, tenderness and rigidity in upper right abdomen without muscle spasm again raised the serious question which had already been con-

TYPHOID SPINE

December 9 daily colonic irrigations with normal salt solution were begun. On December 19, 1914, hæmoglobin 80 per cent, red blood-cells, 5,310,000, leucocytes 9000. Patient continued to improve. On January 2, 1915, leg extension discontinued because pain had practically disappeared, but remained in bed till January 19, when he was up in wheel chair for first time, and his fourth X-ray was negative. Sacro-iliac tenderness is gone. Lumbar spine still rigid. Lumbar curve still wanting. Has distinct tenderness over lateral aspects of third lumbar vertebra, but median tenderness nearly absent.

He is being skiagraphed each week both with expectation of showing bone changes ultimately in his lumbar spine and with intention of ascertaining at what stage organic changes sufficient to be shown by the X-ray take place.

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ble, considerable tympanites, temperature 102° F, pulse 124, hæmoglobin 60, red blood-cells 4,090,000, white blood-cells 4800, urine a trace of albumin, hyaline and granular casts Widal positive two days later

On September 20 had urticarial eruption on back and right arm which left the following day By October 30 temperature practically normal

On November 2 complained of pain in left iliac and left sacro-iliac regions On November 4 sacro-iliac region was strapped with adhesive plaster On following day it was noted strapping had not relieved pain, on November 8 was still complaining of some pain and there was some tenderness over left sacro-iliac joint

On November 10 it was noted that pain and tenderness were not constant On November 18 X-rays of spine, sacro-iliac joints and right hip negative On November 20 pain variable Patient refused to sit up though encouraged to do so

On December 3, I first saw the patient by the invitation of Dr Stengel, who has kindly permitted me to report this case from his service

Patient is a Belgian, at present somewhat neurotic, and, by reason of his understanding English only imperfectly, it is rather difficult to obtain accurate information from him He complains of pain in the lower back, right sacro-iliac region, right lower abdomen and right thigh He presents distinct localized tenderness posteriorly over the middle and lateral aspects of the third lumbar vertebra and over the right sacro-iliac joint Anteriorly there is no midline tenderness at or above the umbilicus on deep pressure Below the umbilicus fairly deep pressure does not cause any distress, but on making firmer pressure so that the palpating fingers finally come in contact with the body of the third lumbar vertebra the patient cries out and squirms away from the examiner's hand

The normal lumbar curve is lost and the lumbar spine is held rigidly Efforts at forward or lateral flexion or hyperextension cause pain The patient turns over or sits up in bed with difficulty because of increased pain He apparently has ample strength to handle himself readily but on moving exhibits the awkwardness characteristic of patients having an acute spinal inflammation On sitting up with his feet over the side of the bed he persists in supporting his weight by his hands placed on the mattress Downward pressure on his head causes pain in the midlumbar region His knee-jerks are present and equal on the two sides

A second set of X-ray pictures were taken with negative results On December 8 weight extension was applied to both legs and in 48 hours all of his pains were decidedly better On



FIG. 1—Dislocated scaphoid or bone. A—Uninjured wrist (for comparison). B—Injured wrist.

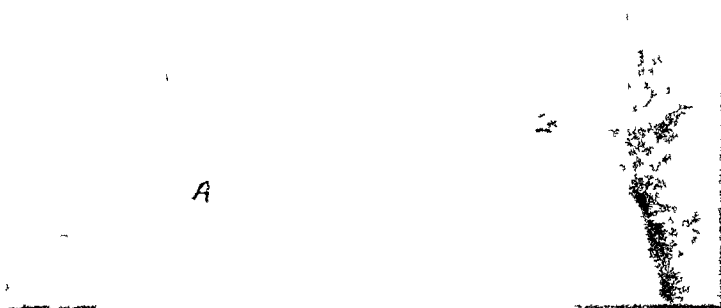


FIG. 2—Condition after reduction. A—Uninjured wrist. B—Injured wrist.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY

*Stated Meeting, held at the New York Academy of Medicine,
December 9, 1914*

The President, DR FREDERIC KAMMERER, in the Chair

DISLOCATION OF THE SEMILUNAR BONE

DR JOHN DOUGLAS presented a man, twenty-six years old, who on October 19, 1914, fell from a platform twelve feet high, striking on the palm of his left hand and sustaining an anterior dislocation of the semilunar bone. There was not sufficient swelling to mask the characteristic deformity, a depression on the wrist dorsally from which the bone had been displaced, below which could be felt the prominent head of the os magnum, while on the anterior aspect of the wrist could be palpated the dislocated semilunar bone. Radiographic examination showed that the bone was dislocated anteriorly and twisted upon itself so that the concave distal surface faced the palmar surface of the wrist instead of the fingers.

The patient refused to take an anæsthetic, but reduction was easily accomplished by hyperextension of the hand by an assistant, while pressure was made with both thumbs on the dislocated bone anteriorly, followed by hyperflexion. At the present time, seven weeks after the injury, there was complete restoration of all function and motion in the joint.

This case was shown, Dr Douglas said, not because dislocations of the semilunar were rare, the injury frequently being associated with fracture of the scaphoid, but because most cases had required an open operation for reduction or excision of the bone, usually because of delay in making the diagnosis. Codman and Chase, in their report of twelve cases in the ANNALS OF SURGERY (vol xli, 1905, page 863), were obliged to resort to an open operation in all but two of their cases, although they state that reduction may be effected even after a period of five weeks. Also the necessity of open operation in most cases was shown by the reports on the subject in literature.

COMPLETE EXCISION OF A TUBERCULAR URETER

COMPLETE EXCISION OF A TUBERCULAR URETER FOUR YEARS AFTER NEPHRECTOMY

DR BENJAMIN T TILTON presented a woman, thirty years old, who was subjected to a nephrectomy ten years ago, the left kidney being removed for tuberculosis of the kidney. Following this operation, a sinus persisted in the left loin for four years in spite of three subsequent operations undertaken to close it. On the supposition that the persistence of the fistula was caused by the stump of a tubercular ureter, it was decided to excise the entire ureter through an anterior incision. The usual "hockey-stick" incision was made and a very much thickened ureter was found and separated from the posterior surface of the peritoneum down to the entrance of the bladder, where it was ligated and the stump cauterized. The upper end was then freed, the sinus circumscribed by an oval incision, and the entire tract from the skin to the bladder removed in one piece. The patient made an uneventful recovery and the wound healed without further delay.

The specimen showed a dilated portion of the pelvis of the kidney and a ureter about the size of the adult finger. The persistence of the fistula was evidently due to the portion of the kidney pelvis that had been left behind. For this reason it seemed unfair to ascribe the fistula to the fact that the ureter had not been removed. The speaker said that in his experience it was sufficient to ligate the ureter well below the kidney in performing nephrectomy for tubercular kidney, and cauterize the stump. He had never seen a fistula result after such a procedure in spite of the ureter being left undisturbed.

DR GEORGE E BREWER said he could personally recall but a single instance where he was called upon to remove the remaining section of the ureter after a nephrectomy for tuberculosis of the kidney. It was his rule in these operations to make a rather long incision and cut off the ureter as low down as possible. He recalled a remark made by Dr Willy Meyer at a meeting some years ago, that if we removed the principal focus of infection in these cases, nature would take care of the rest. The speaker said that in the case he had in mind the ureter was about the size of his finger, and he removed it as far down as the brim of the pelvis. A fistula developed, and at the second operation he found—not a tuberculous ureter, as he had expected—but a bit of crumpled catgut that had formed part of the ureteral ligature.

DR ROBERT T MORRIS said that much depended on the post-operative care of these patients. Personally, his experience was very much like that of Dr. Brewer, and after the removal of a tubercular kidney he usually left behind a good section of the ureter, on the principle that

NEPHROLITHIASIS

The case was regarded as one of hydronephrosis, and on October 5, Dr Eliot made the usual lumbar incision on the right side, and found the peritoneum extending laterally in the region usually occupied by the kidney. As far as the bodies of the vertebrae no kidney could be felt, and the upper part of the mass, on opening the peritoneum, was found to be a large projecting lobe of the liver. Through this opening the gall-bladder was explored, showing no evidence of cholelithiasis. The peritoneum closed, incision was extended downward and forward, and at the crest of the ilium the upper limit of the hydronephrotic sac was encountered. Its sac was closely adherent to the perirenal tissue, and at one point it was so thin that it ruptured during the manipulations.

The entire cyst, together with the kidney, was removed, and the wound closed with a cigarette drain.

The two interesting features of the case were, first, the fact that the hydronephrosis was associated with a Riedel's lobe of the liver, which obscured the diagnosis, second, the question as to whether the hydronephrosis involved a displaced kidney or a dystopia (unascended) of the kidney. The fact that the renal vessels ran downward and forward from their normal origin in the aorta indicated that the kidney had been displaced downward and that it was not a true case of *dystopia renalis*, in which the renal artery usually rises from the lower aorta or common iliac trunk.

The patient made a satisfactory recovery from the operation and had been free from symptoms since.

NEPHROLITHIASIS

Dr Eliot presented an Italian boy, nine years old, who was admitted to the Presbyterian Hospital on November 9, 1914, with the history that for the past six months he had suffered from daily attacks of general abdominal pain, sharp and sudden in onset, lasting from twenty minutes to one hour and becoming localized in the hypogastric region. At times, these attacks were associated with hæmaturia and followed by nausea, vomiting, chills and fever. The attacks usually came on during the act of micturition, the pain being cramp-like and so severe that it doubled the patient up. At times the pain occurred when he made a sudden movement and it was often quickly relieved by lying on his stomach. The last attack had occurred about one month ago. He gave a history of four severe attacks of hæmaturia, passing a large amount of bright red blood which left a heavy sediment in the vessel. The passage of blood did not increase nor lessen the pain.

Past history. It was learned, on inquiry, that the boy had suffered

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removal of a chief tubercular focus allowed nature to care for the remainder. The patient's general nutrition, etc., then required careful supervision, as in dealing with tuberculosis elsewhere in the body. In some of his cases he had removed the entire ureter by Dr. Lilienthal's method, which he considered a very excellent one.

AN UNUSUAL CASE OF HYDRONEPHROSIS

DR. ELLSWORTH ELIOT presented a woman, forty-three years old, who was admitted to the Presbyterian Hospital on October 2, 1914, and who complained of sudden attacks of sharp, stabbing pain in the right, upper quadrant of the abdomen, persisting for two or three days and then subsiding quickly, leaving a soreness of the right flank. These attacks were not associated with chills, fever, headache, nausea nor vomiting. The first attack occurred ten years ago, and came on suddenly while the patient was stooping, since then the attacks had recurred at intervals of from one to five months, and she had had two attacks since January, 1914, the last one being more severe than the others and confining her to bed for ten days. The pain, which was sudden, usually came on during some bodily exertion and was localized on the right side of the abdomen. It was aggravated by bending forward, and was eased by lying quietly in bed with hot applications to the side. It usually subsided quickly.

The patient's urination during the course of these attacks showed no change. She usually voided urine three or four times daily and gave no history of the sudden passage of large quantities of urine nor burning during the act of micturition. The urine was of normal amber color, acid, with a specific gravity of 1020, it was free from albumin and contained a few epithelial and white blood-cells. The patient's menstrual history was negative. She showed a tendency to constipation.

Cystoscopy (by Dr. A. T. Osgood). The bladder held 300 cc without pain. The vesical mucous membrane was normal in appearance. The right ureteral orifice was small and catheterized with difficulty and the catheter was obstructed 20 cm. from the ureteral orifice. No urine was secreted from this side during the fifteen minutes that it was observed. The left ureter was secreting normally.

At the time of the patient's admission to the hospital examination revealed a tumor the size of a football extending from the free costal margin on the right side down into the iliac fossa. It was smooth, oval and elastic, readily palpable, with a slight depression near its upper limit.

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At the present time there is practically complete flexion and extension at the wrist. There is some limitation of supination and pronation; an arm cannot be brought into quite as complete extension at the elbow as the right, although the degree lost is too small to mention.

Dr Hitzrot called attention to the fact that fractures of this type were undoubtedly very rare, and that in so far as he was able to ascertain, this was the only case of this type at the New York Hospital since the advent of the X-ray. The old pathological collection at the New York Hospital contained two specimens of a similar type: (1) a dissected specimen of a fracture at the lower end of the radius with displacement of the distal fragment, and coincident dislocation of the head of the ulna, and (2) a plaster cast of the same form of fracture.

Callender (*St Bartholomew's Hospital Reports*, 1865, 289) reports a similar case due to forced flexion in which the deformity was impossible. Ten months later the deformity persisted and there was no generation of movements in flexion with limitation of extension and straight line and good rotation.

Dr J B Roberts, in a paper read before the American Association upon fracture of the lower end of the radius, with displacement of the carpal fragment (*Trans Amer Surg Assn*, 1896, vol xiv, p 611) reports 4 personal cases of this type, 9 cases obtained by personal correspondence, and 9 other cases from the literature, and 31 cases preserved in various museums which are similar in type, but not identical with the case presented.

Roberts states he has seen no case in its recent state in which the functional result in his personal cases in which it was stated that there was present limitation in extension and flexion with pronation and supination completely lost (case two) with great limitation in the use of the arm and (case one) with perfect use of the wrist and fingers.

In the *International Clinics*, vol 1, Series vii, 1897, p 100, mentions another case of this type with reduction and functional recovery.

BONE CYST, PATHOLOGICAL FRACTURE OF HUMERUS

Dr J M Hitzrot presented a man who was admitted to the Surgical (Cornell) Division of the New York Hospital 1914, with a history of having fallen through a door on his left arm six days previously. There was no previous injury or difficulty with the arm and his past history was in every way normal.

When admitted there was a fracture of the left humerus.

ULCER OF THE STOMACH

himself for examination, when he was unable to move the shoulder in any direction without pain. All motion in every direction was limited to the barest possible amount and such abduction as was possible was due to movement of the scapula.

A skiagraph showed a fracture which, before operation, was interpreted as a fracture of the greater tuberosity with comminution of the fragments. One of the fragments was seen to be displaced into the subacromial space, and because of its presence there, an operation was deemed advisable.

April 8. A three and one-half inch anterior incision was made, splitting the anterior fibres of the deltoid. The fragment seen in the X-ray lay in the subacromial bursa which was markedly injected and plastered together by numerous veil-like adhesions. These were broken up and the fragments which were still adherent to the bone above the attachment of the supraspinatus tendon were cut away. A small rent was then found in the joint capsule just internal to the attachment of the above-mentioned fragment. This was enlarged and the joint found slightly distended by a blood-tinged, viscid fluid. Extending into the head there was a long fissure which at the capsular attachment broke into a number of irregular lines which separated a number of small fragments of bone and cartilage from the articular surface of the bone. All these last mentioned fragments were within the joint. These were removed and the joint washed out with saline solution, a small rubber drain placed in the subacromial bursa, the incision closed with plain catgut, and the muscle and skin closed in layers with plain catgut, with silk-worm-gut in the skin.

Balancing was begun on the third day after the operation, and massage and passive movements on the fifth day after operation. The motion increased and was much less painful than before operation. The drain was removed on the third day. Voluntary motions such as are recommended for surgical neck fractures were encouraged. At the end of ten weeks abduction to beyond a right angle and one-half normal external rotation was possible without pain, and at present there is only limited motion in forced abduction beyond the horizontal and in extreme external rotation. Curiously enough internal rotation remained limited for a longer period than external rotation, and pain on internal rotation was present up to the fifth month. All pain had now disappeared.

ULCER OF THE STOMACH, RESECTION IN CONTINUITY

Dr. GEORGE WOOLSLY presented a man, aged thirty-eight, who was admitted to Bellevue Hospital on December 23, 1914, complaining

formation and shows X-ray photographs of a number of cases to this one. The large amount of cartilage would suggest the case the cyst might resemble Virchow's classical case of cyst in an enchondroma. Elmslie's cases were cured by simply removing the tumor material, after which the fractures healed. There were no giant-cells in this case and there was no evidence of old fracture to place the case in the category recently called hemorrhagic cyst by Barrie (*Surg, Gyn and Obstet*, July, 1914, p 42) formation.

There was no evidence of any other bone cysts in the

DR CHARLES H. PECK reported having had a case of bone cyst of the humerus which had been fractured twice in 1911, again two years later. Recently the patient had injury to the shoulder. The cyst was quite long, occupying on at least, of the shaft of the humerus. Above it there was normal bone, one and a half to two inches, between the upper epiphysis. There was at present no solution of the cyst. Dr. Peck asked Dr. Hitzrot what the latter would consider treatment in such a case. Elmslie considered most of very similar in type, and all benign. He (Elmslie) advised removing and scraping the cyst, but in a number of his cases further examination showed that re-formation of the cyst had occurred. In other words, the cases were not entirely cured by this method. The speaker wondered if it would not be better to do

DR HITZROT said this was the only case in which he had used the bone-graft method. He had had one case in which he removed the cyst, according to Elmslie's suggestion, but the patient died of sepsis and he did not know the final result. In the other cases there was no re-formation of the lesion in the area occupied by the original cyst. The graft showed no cyst formation, therefore, the cyst, therefore, must have come from the surrounding tissue. In answer to Dr. Peck's question, he thought it decidedly best, in case of re-fracture, to entirely remove the part involved and use the bone-graft method.

FRACTURE OF THE HEAD OF THE HUMERUS

DR J. M. HITZROT presented a man, aged fifty-one, who fell down a hatchway three weeks previous to admission. At the time of falling the patient landed on the point of his left shoulder, which became swollen and the disability which was caused for the first few days gradually increased up to the time

RESECTION OF SIGMOID FOR GANGRENE

DR WILLIAM A DOWNES called attention to Von Eiselberg's report of 18 cases of transverse resection of the stomach without mortality. This author says in properly selected cases no other type of operation seemed to him to be as satisfactory. Dr Downes had had two cases in which he operated by this method, in which results, as shown by the X-ray, were very satisfactory. There was no atrophy or other abnormal condition at the pylorus. He considered gastroplastic operations on the lesser curvature very unsatisfactory. He mentioned one of his cases in which the stomach had become fixed posteriorly to the pancreas, the patient suffering a great deal of pain. Complete resection was preferable.

DR FREDERIC KAMMERER thought a contraction at the point of resection, resulting in hour-glass formation, was not as likely to occur after a V-shaped excision along the lesser curvature as after a complete resection in continuity. The less satisfactory results of the V-shaped excision were to be attributed rather to the change in the configuration of the stomach following this operation, which did not follow complete transverse resection.

DR JAMES M HITZROT recalled a case in which he performed a V-shaped resection on the lesser curvature, with the subsequent report that the patient was improved by the operation. X-ray examination showed contraction of the lesser curvature which had changed the angle of the duodenum so that there was retention. Bismuth remained in the stomach for 17 hours. At the second operation it was found that there was a water-trap stomach, with adhesions along the posterior line of sutures. The patient was relieved by gastro-enterostomy.

DR JOHN A HARTWELL mentioned cases which he had seen operated at the Mayo Clinic, by the method of cauterizing directly through the ulcer, and suturing the defect thus produced. In cases where the ulcer was removed by a V-shaped resection, he thought in most cases it was better to do a gastro-enterostomy at that time.

RESECTION OF SIGMOID FOR GANGRENE RESULTING FROM ENDARTERITIS OBLITERANS

DR WILLIAM A DOWNES presented a man, aged forty, who was admitted to St Luke's Hospital on December 19, 1914, with a history of sudden seizure of severe cramp-like pain in the lower abdomen on the day before admission to the hospital. Previously there had been no gastro-intestinal symptoms, no jaundice, no diarrhoea, bowels had been regular as a rule, and patient had noticed no recent loss of weight.

chiefly of epigastric pain and vomiting, with a previous history similar attack about a year before, prior to which time he had been sick. The present illness began about a week before, with pain and then vomiting about an hour after breakfast. Then he felt hungry and thereafter vomited after eating or drinking. Pain in the epigastrium was more or less continuous. December 24, he had typical coffee-ground vomitus. After the vomiting ceased and there was little or no pain. Blood haemoglobin 75 per cent, Wassermann, 4 units, positive. Examination showed cardiac arrhythmia (lucetic). X-ray showed ulcer curvature, no pyloric stenosis. Free hydrochloric acid 0.31.

Upon operation, January 2, 1915, a moderately indurated ulcer the size of a half dollar, was found on the lesser curvature, 4 or 5 cm. or more from the pylorus. Slight glandular enlargement of the lesser curvatures. Mesogastric resection, including ulcer. There was no difficulty in suturing at the lesser curvature, otherwise the operation was simple and easy. After operation there was no pain and no vomiting. The only complaint was hunger, and the patient was kept on a diet with addition of alkalies for two and a half weeks. In the two weeks prior to the date of the meeting he gained twenty-four pounds. Pathological report showed gastric ulcer with no evidence of malignancy. X-ray after operation shows the pyloric end as a teat-like projection from the rest of the stomach. Though it lies a little to the left of the median line, it is probably foreshortened, as at least three inches of the pyloric end was left.

This case is the one referred to in the discussion on the paper at a previous meeting, and is shown on account of the ease and simplicity of the method, and the smoothness of the operative course. Dr. Woolsey mentioned the fact that if an excision of an ulcer in this position was made the operation would prove difficult, and the stomach likely to be distorted into a J-shape, and that in his experience it was necessary to perform an excision a gastro-enterostomy in order to obtain a good result.

In this case the stomach emptied itself completely in fact the emptying was more prompt than normal, judged by the advanced position of the bismuth in the colon. Pylorus was spared, for most if not all of the nerves passing to the stomach were divided in the resection. This operation gives better results with subsequent complications than any other operation for gastric ulcer.

A lateral anastomosis was done between the terminal ileum and the distal end of the sigmoid. A stab wound was then made in the left upper quadrant with a gauze drain to the proximal stump of the sigmoid and a rubber dam drain to the site of anastomosis.

Pathological Findings—From the lower portion of the sigmoid up to the splenic flexure, the colon was thickened and indurated. Tissue was very friable. At the level of the anterior superior spine the colon was adherent to the parietal peritoneum and the walls congested and oedematous. The omentum was adherent at this spot. The wall of the colon was thickened and appeared subacutely inflamed, but there was no suggestion of tuberculosis or malignancy. Pathological examination showed gangrene of the descending colon, obliterative endarteritis and chronic inflammation.

FETAL ADENOMA OF KIDNEY, NEPHRECTOMY

DR CHARLES H. PECK presented a girl, aged three years and eleven months, who was admitted to Roosevelt Hospital on November 6, 1914, with a history of having complained about three months previously of occasional abdominal pain, relieved by catharsis. Little attention was paid to it by the mother, and nothing wrong was noticed further until early in November, when a swelling in the right side of the abdomen was first discovered. She was then brought to the hospital. The swelling was found to be a tumor of the right kidney as large as a grape-fruit. The child was considerably emaciated, but otherwise did not seem ill. The tumor was thought to be probably malignant, but operation was advised. The parents refused and took the child away.

The child was not seen again until January 14, 1915, when she was again admitted to the hospital. In the interval she had emaciated greatly, the tumor had increased in size enormously, and the superficial abdominal veins were dilated. The child was very anæmic and the outlook seemed almost hopeless. The parents now wished operation as they had finally become convinced that the child was failing rapidly.

The hæmoglobin was 39 per cent, red cell count 3,700,000, leucocytes 9,400, polymorphonuclears 80 per cent. The size of the tumor, the anæmia and cachexia made the outlook seem nearly hopeless, but after careful consideration the attempt at removal was finally decided upon and undertaken on January 16.

Enucleation was effected with a good deal of difficulty. The capsule was quite adherent in many places and at the upper pole some necrotic portions of tumor had to be removed before delivery could be effected. An opening in the peritoneum was made intentionally in the course of

or strength For the past year there had been pain in the legs, the left one, for which he had been "baked" There was of gonorrhœa at twenty, syphilis was denied

The pain in the lower abdomen was a little worse on the than on the right, varied in severity, but was present consistently from its onset There had been no movement of the bowels, and even though he had been given several enemata no flatus was expelled, he passed a small amount of bright red blood following the enemata The patient had vomited several times since the onset of the illness and had been continually nauseated There had been no frequent micturition, but urination was difficult and less had been passed lately There was no pain in the back and no hæmaturia

The entire abdomen was tender, with the tenderness more marked in the left lower quadrant No masses or rigidity could be felt Otherwise, the examination was entirely negative except that the hands and feet were cold and slightly cyanotic, with no pulsation in the arteries at the ankles The temperature was $100\frac{2}{5}^{\circ}$, pulse 58, and respiration 30 The white blood count 28,000, polymorphonuclears 84 per cent, lymphocytes 16 per cent Four hours later, white blood count 28,000, polymorphonuclears 84 per cent, lymphocytes 18 per cent The urine was acid, clear, with a specific gravity of 1010 There was a trace of albumin, no sugar, and few leucocytes and epithelial cells

On December 21 an X-ray examination, bismuth series, showed the stomach to be normal in size and position The emptying of the stomach was fairly normal, it being completely emptied in six hours There were large amounts of gas in the colon At the end of 47 hours, the meal had reached the splenic flexure and some was in the descending colon At the end of 54 hours after simple enema, there was a slight advance in the meal, which suggested delay in the sigmoid

On December 28, a bismuth injection travelled to the cæcum, showing a very peculiar appearance over the region from the splenic flexure to the sigmoid, which showed much narrowed calibre suggestive of stricture or extreme spastic condition Cystoscopic examination revealed nothing abnormal in the bladder or ureters Wassermann test was negative, as was also the cerebrospinal fluid Rectal temperature had been 98° to $99\frac{2}{5}^{\circ}$ for eleven days

The patient was operated on December 31 by a left rectal incision six inches long After freeing omental adhesions, the sigmoid was found adherent to the peritoneum It was dissected free and surgically opened A section of the sigmoid five inches long was removed and the distal end inverted with purse-string of fine

HIGH FREQUENCY CURRENT FOR VESICAL PAPILLOMATA

remove the growth and re-implant the ureter would have been too severe a strain for a patient of this age and in her poor condition. In eight seances, aggregating $13\frac{1}{4}$ minutes total application of the Oudin current, the tumor was painlessly destroyed, and the patient had been completely restored to health.

This patient has been recystoscoped 12 times during the past 5 years and shows no sign of recurrence.

The second patient, a woman sixty-six years of age, was admitted to Mt Sinai Hospital on April 6, 1910. The symptoms began ten years before, with hæmaturia lasting several weeks, increased frequency of urination, and burning on urination. In June, 1907, she had a second attack of hæmaturia lasting three months. At that time Dr. Beer cystoscoped the patient at the German Hospital and found a papillary tumor the size of a hazel-nut a little to the left of the left ureteral meatus. The patient refused operation. One year before her admission to the hospital the third attack of hæmaturia began, lasting two weeks. The fourth attack began nine weeks before admission. When admitted to the hospital the urine was very bloody, frequently containing large clots. Urination was every half hour during the day, and three or four times at night. There was marked tenesmus. The patient had lost much weight and was steadily growing weaker. Patient was almost exsanguinated. At the first treatment the bleeding ceased, so that the tumor was readily seen in subsequent examinations. It was made up of fine villi and coarse bulbous papillæ, it was sessile, and of about the size of a half-dollar. By means of the high-frequency current (Oudin), employed in four seances aggregating 14 minutes' application, the growth was totally destroyed.

This patient has been recystoscoped about 12 times during the past 5 years and no signs of recurrence are visible.

The third patient, a man fifty-four years of age, presented symptoms of tumor dating back 22 years. Examination showed one of the most extensive papillary growths he had ever seen. The tumor stretched from the neck of the bladder across the trigone, over the left ureter, and the left two-thirds of the trigone, thence up the left lateral wall and posterior walls to well above the equator, taking in between one-quarter and one-third of the whole bladder wall. This patient was difficult to treat, not only because of the great size of the growth but also on account of severe bleeding and of bladder irritability. In 9 seances aggregating 34 minutes' application of the current, the whole tumor was destroyed and gradually thrown off in large and small pieces. The patient was restored to excellent health.

enucleation, and altogether the delivery was much more difficult than often the case in these encapsulated kidney tumors. It was effected, however, and the pedicle was satisfactorily secured. The wound was closed, with a small dressed tube drain placed posteriorly.

The operation was fairly well borne and the shock moderate. Considering the difficulty of the procedure and the great amount of blood lost, the child's convalescence has been uninterrupted and she has gained considerably in weight and general condition.

DR WILLIAM A. DOWNES had had nine of these cases at the Hospital. Four had died as immediate result of the operation, the remaining five, all died later, with the exception of one, operated on months ago. He doubted, however, if this patient would live long. Various diagnoses had been made in each case.

DR FREDERIC KAMMERER's experience had been that most kidney tumors recur very soon after operation. In very large tumors expected difficulties might arise during operation. In one of his cases the speaker had operated on, a girl of seven, the separation of a large mass from the surrounding tissues was rather easily accomplished until the pedicle was reached. There the tumor-mass had enlarged blood vessels and, in attempting to free the pedicle, the left ureter was torn or cut from the aorta, causing a hemorrhage, to which the patient succumbed.

END RESULTS OF HIGH FREQUENCY CAUTERIZATION OF VESICAL PAPILLOMATA

DR EDWIN BEER presented three cases, bringing their results as published in detail in the ANNALS OF SURGERY for August, 1910, date.

The first patient, who was a woman eighty-one years of age, first seen, was admitted to Mt Sinai Hospital, First Surgical Service, on February 24, 1910. According to the history, she had had hematuria irregularly for two years, passing clear urine between attacks, with increased frequency during attacks, and without pain. She had a loss of weight and strength. Upon physical examination the bladder was found to be poorly nourished and very anæmic. Cystoscopy revealed a large papillary growth stained with blood, surrounding the ureteral meatus and extending well to the right toward the lateral wall. The villi were very exuberant, protruding approximately into the lumen of the bladder. The growth was slightly lobulated and of the size of a silver dollar, the main part of the growth being to the right of the right ureteral meatus and apparently

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This patient has been recystoscoped 8 times during the years and his bladder shows no sign of recurrence

NOTE—These three cases are the original cases on which frequency cauterization method was employed and consists of three cases on which this new technic was tried

TRANSPERITONEAL RESECTION OF BLADDER FOR CARCINOMA ENUCLEATION OF PROSTATIC ADENOMA

DR BEER presented a man, aged sixty years, who, three years ago, began to have painless hæmaturia. In April, 1912, cystoscopy on the posterior wall of the bladder a rather fleshy, slightly pedicled growth, the size of a silver half-dollar. This was cauterized with the high-frequency current. Specimens obtained during voided urine were at first unsatisfactory. Cystoscopy as the patient had a large prostate. After the second specimen obtained showed malignancy. This, together with cystoscopic picture and the failure of the cauterization to destroy part of the tumor, compelled him to do a partial cystectomy, April 1912. The whole posterior wall into the trigone was excised tonically, and the defect was then closed by two layers of inner chromic gut, and an outer Pagenstecher (continuous), was placed in Douglas's pouch and, the bladder being complete, a permanent catheter was introduced through the urethra. A post-operative examination showed an infiltrating carcinoma. The patient had a satisfactory recovery. As the catheter did not work well it was removed and the patient voided spontaneously after the first day. Two weeks after this operation the patient began to have severe nocturnal urination, and it was thought, by several surgeons whom he consulted, that he had a recurrence. His symptoms suggested stone, and examination showed in December, 1912, two shadows in the bladder region. The original incision was opened and two calculi were found, one was hanging on the Pagenstecher suture. At this point the suture material that was visible was excised. There was no evidence of recurrence of the growth. The prostate was dissected out. By February, 1913, another stone had formed, and on cystoscopy readily seen hanging by a thread into the bladder. For the treatment of cystitis and an intravesical projection of the prostate, the negative through the cystoscope. Again the bladder was the object of removing the stone and the prostatic adenoma. The rest of the Pagenstecher linen and removing

EXTRAPERITONEAL CAUTERY EXCISION OF CARCINOMA

had to be followed into the vesical wall and actually dissected out. The prostatic adenoma was easily enucleated and the stone removed. There was no recurrence of the original growth. The bladder was turned down to a tube opening and in twelve days the patient was passing all his urine. Since the last operation the patient has been absolutely well and his urine perfectly clear. He has gained about forty pounds.

EXTRAPERITONEAL CAUTERY EXCISION OF CARCINOMA OF BLADDER

DR. BEER presented a man sixty-seven years of age, who in 1912 had the first attack of hæmaturia, and in April, 1914, a second attack, with pain and marked increase in frequency. There had been distinct loss of weight, and his general condition was poor. Cystoscopy and high-frequency treatment April 27, 1914. Cystoscopic examination revealed a rather solid papillary tumor on the right anterior wall, and another at the right ureteral opening. Both tumors were surrounded by thickened, oedematous mucosa. Pieces were excised through the operating cystoscope, from both growths, the pathological report being papillary carcinoma on the tumor of the right wall, and papilloma on the ureteral growth. Owing to the patient's wretched condition it was not deemed justifiable to attempt anything radical, and finally it was decided to open the bladder under local anaesthesia and to burn off the growths, thus temporarily controlling the pain and bleeding. April 29, 1914, after exposing the bladder extraperitoneally, it became evident that the right and anterior walls could be resected with some hope of getting out all the growth except the papilloma at the right ureter. Under chloroform, the bladder was completely freed on the right side from the perivesical tissues, which were apparently not involved, and then the bladder was opened and the surfaces of both growths Paquelinized thoroughly to avoid implants. Then, with the hooked cautery, the excision of the carcinoma was performed and the defect in the bladder closed with a double row of catgut sutures. The bladder was drained suprapubically. Recovery, much to the speaker's surprise, was uneventful, and the patient was discharged in four weeks. Inasmuch as the whole procedure was done more with the hope of palliation than of cure, it was a great surprise to find, on examining the patient on November 5, 1914, that his bladder showed no signs of recurrence, and that he was free from all symptoms.

NOTE—These cases illustrate the two methods of procedure in excising malignant bladder disease, the intraperitoneal and the extra-

NEW YORK SURGICAL SOCIETY

This patient has been recystoscoped 8 times during the past 4 to 5 years and his bladder shows no sign of recurrence

NOTE—These three cases are the original cases on which the high frequency cauterization method was employed and constitute the first three cases on which this new technic was tried

TRANSPERITONEAL RESECTION OF BLADDER FOR CARCINOMA, ENUCLEATION OF PROSTATIC ADENOMA

DR BEER presented a man, aged sixty years, who, three years ago, began to have painless hæmaturia. In April, 1912, cystoscopy revealed on the posterior wall of the bladder a rather fleshy, slightly papillary growth, the size of a silver half-dollar. This was immediately treated with the high-frequency current. Specimens obtained during treatment and in voided urine were at first unsatisfactory. Cystoscopy was difficult, as the patient had a large prostate. After the second treatment the specimen obtained showed malignancy. This, together with the cystoscopic picture and the failure of the cauterization to destroy the greater part of the tumor, compelled him to do a partial cystectomy, on July 12, 1912. The whole posterior wall into the trigone was excised transperitoneally, and the defect was then closed by two layers of sutures, an inner chromic gut, and an outer Pagenstecher (continuous). A tube was placed in Douglas's pouch and, the bladder being completely closed, a permanent catheter was introduced through the urethra. Microscopic examination showed an infiltrating carcinoma. The patient made a satisfactory recovery. As the catheter did not work well it was removed, and the patient voided spontaneously after the first day. About eight weeks after this operation the patient began to have severe pains on urination, and it was thought, by several surgeons whom he consulted, that he had a recurrence. His symptoms suggested stone, and X-ray examination showed in December, 1912, two shadows in the bladder region. The original incision was opened and two calculi were removed, after separating their attachment to the bladder wall, to which they were hanging on the Pagenstecher suture. At this operation all the suture material that was visible was excised. There was no evidence of recurrence of the growth. The prostate was distinctly enlarged. By February, 1913, another stone had formed, and on cystoscopy it was readily seen hanging by a thread into the bladder. Except for a cystitis and an intravesical projection of the prostate, the bladder was negative through the cystoscope. Again the bladder was opened, with the object of removing the stone and the prostatic adenoma, and following up the rest of the Pagenstecher linen and removing it. The linen

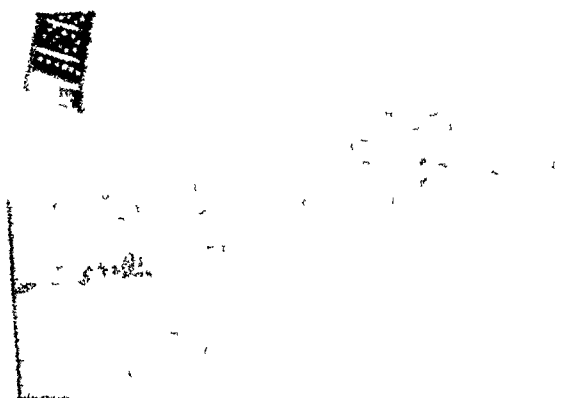


FIG. 1--Sagittal section of the brain.



FIG. 2--Condition after operation. patches of the brain are upward and flattened by the

TRANSACTIONS OF THE PHILADELPHIA ACADEMY OF SURGERY

Stated Meeting, February 1, 1915

The President, DR JOHN H GIBBON, in the Chair

INGUINAL LYMPHOMA

DR D L DESPARD presented a man who had been operated on at the Jefferson Hospital for enlarged inguinal glands. The glands on the left side, smaller than those on the right, were not removed, the largest of the glands of the right side measured, three or four days after removal, 4 cm in diameter. Microscopic examination showed simple hyperplasia of the lymphatic glands, without increase in the fibrous tissue and no evidence of eosinophiles except here and there, nothing to suggest sarcoma or Hodgkin's disease. The cells had the appearance of ordinary lymph cells. History was practically negative. There was no venereal history, Wassermann, negative. He had, however, a leucocyte count of 12,000. The red cells were increased in number to 6,200,000. Beyond this the blood picture presented nothing unusual. The differential count showed polymorphonuclear cells of 66 or 67 per cent, in other respects it was practically normal. The reporter said that he had never seen an ordinary hyperplasia in which the glands were as large as those on the right side in this case. The question is whether this is an incipient Hodgkin's disease or a pre-sarcomatous condition.

DR JOHN H JOPSON said that this case is similar to one in which he had operated for polyglandular enlargement of one side of the neck. Some of the glands were found to be broken down at the time of operation, and the appearance seemed to disprove the possibility of Hodgkin's disease or sarcoma. Pathologists in two laboratories reported the condition tuberculous. There was local recurrence and a second operation was done some months later. This time the glands were examined by Dr Canby Robinson who reported typical Hodgkin's disease.

OPERATION FOR OLD FRACTURE OF THE PATELLA

DR JOHN H JOPSON presented a woman thirty-nine years of age, weighing over 200 pounds, who fell in 1912 and fractured her left patella. She was treated by another surgeon without operation, some

form of an extension apparatus being applied to the muscles of the thigh to aid in bringing about apposition of the patellar fragments. She was in bed for two months, there was marked stiffness of the knee following the removal of the apparatus. Four months after the original accident the fragments became separated during passive motions. She was again in bed for one month. Considerable stiffness persisted and she had some effusion of the joint, but finally she got around with a cane.

In December, 1913, she fell again, injuring this knee. When examined by the reporter, February, 1914, a wide separation of the patellar fragments was found, at least two inches when the limb was extended and correspondingly more when it was flexed. The femoral condyles were plainly felt between the fragments and there was apparently no union. There was a complete loss of power of extension in the knee and the patient could walk only with a cane and had no confidence at all in the strength of the limb. X-ray examination showed two fragments, each of good size, widely separated (Fig. 1). At operation, in March, 1914, the fragments were exposed by the usual curved incision, convex downward. The fragments were connected by a broad, very thin, relaxed sheet of fascia, which permitted complete flexion, but was of no service in extension. There were many adhesions around the fragments and the quadriceps muscle. The broken edges were covered with a thick layer of fibrous tissue. The first step toward approximation of the fragments was a division of the lateral expansions of the quadriceps and loosening of the under surfaces of the two fragments from their adhesions to the underlying bones. A plastic operation was done on the quadriceps tendon by making a V-shaped incision with the apex downward, which manœuvre diminished by about two-thirds the distance between the fragments. The vastus internus and externus were extensively mobilized. As it was still impossible to approximate the fragments, they being about three-quarters of an inch apart, the tubercle of the tibia was chiselled loose from the bone, remaining attached to the patellar tendon and the periosteum on each side, which permitted of its being elevated about $\frac{3}{4}$ of an inch and the fragments of the patella could then be brought into contact, there being some slight tilting of the lower fragments. Both fragments were drilled and a heavy silver wire and two chromic catgut sutures were used to fasten them together. A wire nail was driven through the separated tubercle into the head of the tibia at its new level. The lateral expansions were sutured, the quadriceps tendon repaired, the thin, tendinous flap formerly uniting the fragments used

NASAL OSTEOCHONDROMA

get bony union but a good strong fibrous union with good functional result, giving the woman a very useful limb. The problem in this case to be overcome was atrophy and shortening of the quadriceps muscle. No operation upon the tendon was done. It was forced down, but was not successful in entirely overcoming the shortening of the muscle.

TRANSPLANTATION OF ENTIRE BONES WITH THEIR JOINT SURFACES

DR A. BRUCE GILL read a paper with the above title, for which see page 658.

DR GWILYM G. DAVIS thought that the question, whether or not the bone transplant is absorbed, is perhaps not of great importance. Some of Albee's work, and the work of others, have shown that if the bone is replaced it is replaced almost absolutely in the size and shape of the original bone as inserted. Therefore, whether it is replaced or not replaced, the effect is the same. Suppose if a person has a fracture in the shaft of a long bone, nobody would say that after healing either fragment had been entirely replaced by a new bone. Suppose a fracture occurs close to the articular end, as in Colles' fracture of the radius, does not the distal fragment live? In an osteotomy for hallux valgus back of the articular surface in which the bone is brought straight, does the head of the bone become absorbed and replaced? He hardly thought so. In one such case he took the head of the bone completely out, put it back, and closed up the wound. Healing occurred and the condition was as satisfactory as in the opposite side in which the head of the bone did not come out. Was the transplanted bone absorbed or not absorbed? Experiences like this are not rare even though one cannot positively explain the process from an academical point of view. The implant seems at least to retain its vitality and live very largely in the shape in which it has been implanted. Some of Albee's specimens are very marked illustrations of that. It seemed to him to be begging the question when one sees some of his transplantations of bone of the spine in which the implant is fused absolutely *in situ* and remains almost exactly as when implanted, to question the process. Of course, when a bone dies the death is more or less *en masse* and such grafts come away as sequestra.

NASAL OSTEOCHONDROMA

DR NATHAN P. STAUFFER presented a man, aged thirty years, who had been operated upon two years ago in the Jefferson Hospital for an obstructive growth in his nose. When first seen he had great pain in nose and was unable to breathe through either nostril.

to overlap them. The fat, fascia and skin wounds were sutured, and drainage provided at either angle, the wound being dressed on a posterior splint. There was some superficial necrosis of the fat due to the prolonged manipulation at operation, otherwise convalescence was normal. A splint was worn for three months, passive motions being practised after the wound was healed. There was marked stiffness at first, but this yielded to passive motion and massage. At the present time, the result is as follows. Flexion is almost complete, extension is strong to a point 15 or 20 degrees from the straight line, passive extension is perfect. The patient can walk long distances. She can stand with all her weight on the leg. The patella is movable and the only disability is in going up and down stairs, when she still fears to bring the injured knee ahead of the other. The X-ray (Fig 2) shows excellent apposition and union of the fragments, union of the tubercle of the tibia with some tilting, and the nail, which still remains, has worked into an oblique position in the head of the tibia, but causes no annoyance. The incompleteness of extension is probably due to the high insertion of the patellar tendon with some loss of lever action in consequence.

The case illustrates what can be done in old fracture of the patella, with wide separation, by a combination of a plastic operation on the quadriceps tendon with von Bergmann's method of elevation of the tibial tubercle. Either of these measures alone would have been insufficient to secure approximation in this case, and, while the former has been criticised for resulting in a weakening of the muscle and the latter for not accomplishing very much in the way of approximation, the combination of the two in this case has resulted in a strong, useful limb. One criticism which might be aimed at the elevation of the tibial tubercle is one used by Turner, that it may prejudice the mobility of the joint. There is some slight loss of the power of complete extension here, although this may in time be overcome.

DR GEORGE G. ROSS spoke of a case in which the interval between the time of the accident and of operation was five years. There was a separation of from $2\frac{1}{4}$ to $2\frac{1}{2}$ inches between the fragments. He was able to bring the two fragments together, apparently in perfect apposition, secured by heavy silver wire. Fourteen days later, the patient being still in bed, the wire was snapped by a contraction of the quadriceps muscle, producing a $\frac{3}{8}$ inch separation. She went about in this condition for a year and then the broken end of the silver wire produced a sinus, for which operation was done. While under the anæsthetic another attempt was made to bring the fragments together. They did not

CYSTADENOMA OF THE PANCREAS

The operation succeeded in giving him good breathing space day and night, relieved his headaches, increased his vision and relieved his embarrassment while eating

The question of recurrence is to be determined but the growth can be removed more readily now that it can be seen when first starting and as it is destructive apparently only by pressure this can be prevented by operating. The only other report of a case of nasal osteochondroma that he could find is by Dr Robert Myles in the *Laryngoscope*, page 305, and is interesting in that he had to ligate the external carotid artery to control the hemorrhage

CYSTADENOMA OF THE PANCREAS WITH EXTENSION TO THE ABDOMINAL WALL TEN YEARS AFTER DRAINAGE OF A PANCREATIC CYST

DR JOHN J SPEESE reported the history of a woman aged forty-nine years, who was first admitted to the Presbyterian Hospital in 1904, where she was operated upon by Dr Duer for a large cyst of the pancreas

The cyst wall was so adherent to the omentum and intestines, and the condition of the patient such that prolongation of the operation for the purposes of exploration was not warranted. The neck of the cyst was accordingly sutured to the abdominal wound and a considerable portion excised. The patient made an uninterrupted recovery, the sinus healing completely at the end of two months. Examination of the cyst contents showed pancreatic ferments, the histological examination of the cyst wall revealed fibrous tissue and no lining

The patient was readmitted to Dr Jopson's service on October 13, 1914, with a tumor of the abdominal wall which began three years ago as a small ulcer in the region of the umbilicus. Recently the growth has been rapid, measuring at present 5 cm in diameter, and presents an ulcerated red surface, projecting slightly above the surrounding skin (Fig 3). The edges are hard and indurated, the tumor is friable and bleeds easily, there is an offensive watery discharge which is non-irritative. The umbilicus is apparently involved in the tumor mass

The growth was regarded as a primary carcinoma probably originating in the umbilicus, and was removed by a circular incision. The base of the tumor, however, was found to be attached to the abdominal organs by a definite pedicle, and on opening the abdomen, multiple

A large hard mass protruded from the right nostril. It pressed the septum over, occluding right and left nostrils. Postnasally it could be seen extending to the uvula and appeared to be of connective tissue, well supplied with blood-vessels which easily bled. X-ray report stated that the growth was in or extended into the right maxillary sinus. A tentative diagnosis of sarcoma of the nose was made and immediate operation advised. Operation refused and postponed on account of his wanting to keep a newly acquired job.

September 15, 1914, four months later, he returned with more pain in his nose and severe darting headaches and diminishing vision. Externally nasal bones were pushed out and the face much swollen. He was sent to the Presbyterian Hospital for operation, where on the following day he was anesthetized by the Meltzer intratracheal method. The tracheal tube was lightly packed into the pharynx with two long strips of gauze to prevent inhalation of any blood *via* postnares and mouth, hæmostats were attached to these to keep them in place, the lips being elevated by a retractor, a labiogingival incision made, and the mucosa elevated to the inferior nares. He then cut through the inferior nasal mucosa from below and retracted the tissues but could not get around the growth. The incision was then enlarged by chiselling through the lower portion of the pyriform opening. The tumor was found apparently attached to the anterior end of the inferior turbinal bone. With the scissors this was severed and a large piece shelled out with a broad, curette. The growth extended posteriorly, and piece by piece it was dissected from the mucosa of the right side. A large perforation was found in the septum and the growth filled the entire left naris, partially eroding the left maxillary antral wall. Finally with a finger in the postnares the rest of the mass was easily dislodged. Dr. Speese with the electric needle cauterized the inferior nares where it had been attached and the nose was irrigated with bichloride and packed with iodoform gauze. The labiogingival wound was stitched with catgut and the intratracheal apparatus and postnasal gauze were removed, as the anterior nasal packing was considered capable of controlling hemorrhage. His only bleeding came from the labiogingival wound, which was readily controlled by packing with a strip of one inch gauze. The subsequent convalescence presented no serious complication and he returned home at the end of two weeks. The pathologist reported the growth to be an osteochondroma.

Two months and a half later, December 12, 1914, renewed examination revealed a growth springing from the middle third of the inferior turbinal, possibly with a base in the maxillary antrum.

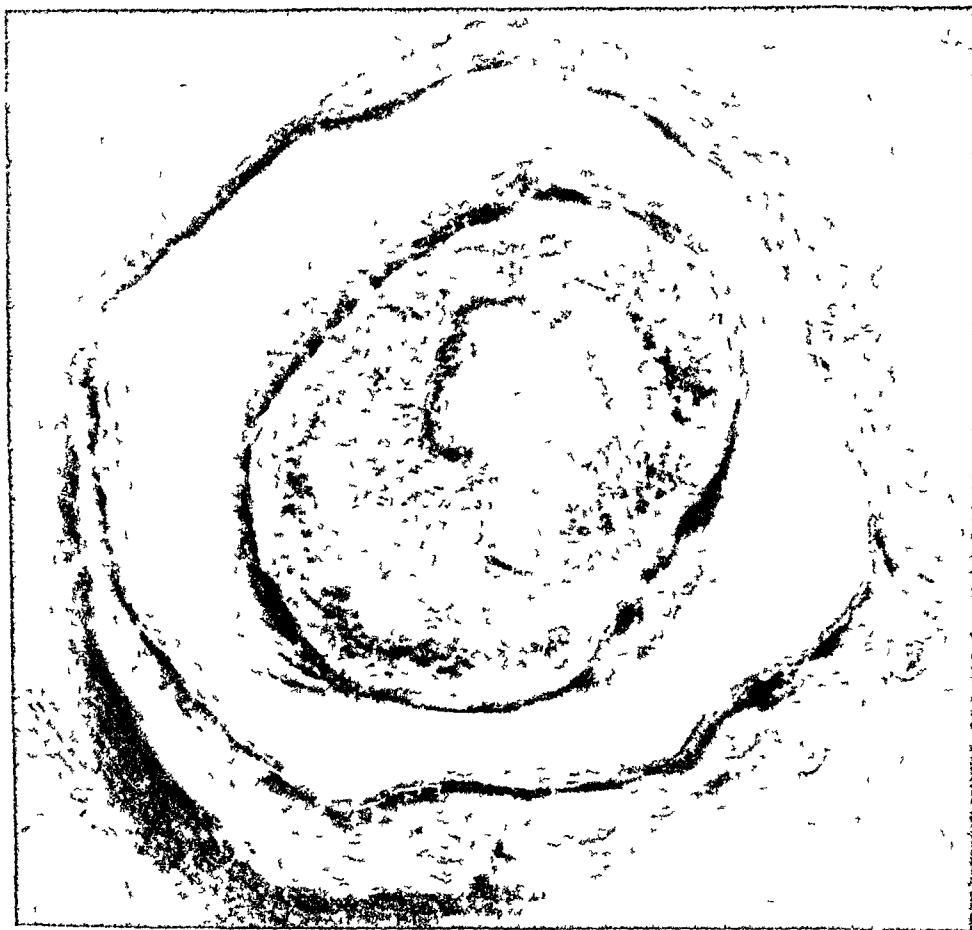


FIG 3 —C₃ stadenoma of pancreas extending to abdominal wall

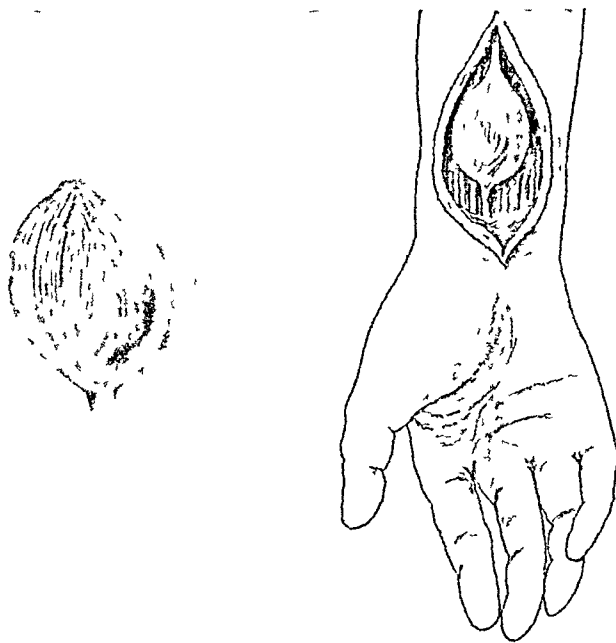


FIG 4 —Cyst of median nerve

small cysts were found, the small intestine and the transverse colon were so firmly adherent that it was impossible to explore the region of the pancreas or to do any form of radical operation other than removal of the superficial tumor from its pedicle. The wound was closed as in the Mayo operation for umbilical hernia, and a small drain inserted down to the stump of the pedicle. The patient made a slow convalescence, the sinuses gradually closing, but draining a small quantity of fluid when last seen, February 1, 1915.

The examination of the patient's stools showed no abnormality in digestion. The urine contained small amounts of albumen but no sugar. The quantity of fluid in the cysts removed with the tumor was too small to examine for ferments.

Pathological Examination—The specimen consists of a tumor which is entirely surrounded by an intact area of skin. The mass projects 1 cm above the level of the skin, is round in shape and measures 5 cm in diameter and 3 cm in thickness. The tumor is bright red in color, the surface presenting small areas of ulceration, and at its lower pole is partially covered with skin to which it is firmly attached, while at the upper margin there is a distinct furrow between the tumor and the skin. The base of the tumor contains a smooth glistening membrane (peritoneum) to which several masses resembling omentum are attached. A cross section shows that the mass is composed of tissue which is white in color, dense in consistency and contains numerous cysts varying in size from a pinhead to cavities 1 cm in diameter. The cysts contain a colorless mucilaginous fluid, the walls are smooth in appearance.

On microscopic examination the sections show a process consisting of a dense connective tissue stroma in which are embedded glandular elements presenting various stages of activity. For the most part the acini are fairly large and present a very moderate degree of dilatation. In these acini and in the smaller cysts the lining is composed of high cylindrical epithelium containing many goblet cells, and the cysts are filled with a blue mucoid material containing desquamated cells. In many of the cysts the epithelium is greatly compressed and is flattened in appearance, in others it is thrown into folds by reason of fibrous ingrowth so that many minute papillary processes are present. Toward the superficial portion of the tumor the cystic nature is less marked and the acini more numerous. The slightly dilated glands are found immediately beneath the skin surface, the squamous lining of the latter has become broken and in some places is in direct apposition with the cells of the acini. In this area the stroma contains a round-cell infiltration and traces of blood pigment. Many blood-vessels are found in the stroma, but no evidence of normal pancreatic tissue can be found anywhere.

The diagnosis of a *proliferating cystadenoma of the pancreas* with extension to the abdominal wall at the point of drainage ten years previously, is based upon several factors. There can be little doubt concerning the original diagnosis of pancreatic cyst as ferments were found in the fluid. The findings at the second operation coincide with the picture frequently met with in such cases, and the histologic examination points to the same conclusions.

CYST OF THE MEDIAN NERVE

Of the many interesting facts brought out by a study of the case, emphasis can be made upon the very benign and comparatively mild course of the new growth, a fact noted by all writers on this subject. It would seem that drainage of the large cyst retarded further growth for many years, and doubtless many more would have elapsed without trouble if extension of the process had not been favored by the attachment of the large cyst to the abdominal wall. It is also noteworthy that sugar was not present in the urine during either stay in the hospital and that the growth had little or no effect upon the general health or nutrition of the patient.

CYST OF THE MEDIAN NERVE

DR SPEESE also related the history of a woman, aged sixty years, who struck her forearm two years ago in falling. She experienced very little pain from the injury, but noted shortly afterward that there was a distinct swelling above the wrist, and that this gradually enlarged but caused no discomfort. Three weeks ago she felt a sudden sharp pain in the forefinger, the pain radiating to the elbow. The severity of the pain has increased, becoming constant, at times interfering with sleep, and is unrelieved by any local or general measure. The patient asserts that the pain never arises in the tumor itself, always in the forefinger, radiates upward, and rarely is localized to the swelling in the wrist. She is able to use the fingers although motion causes some pain; there is no loss of sensation or atrophy of the hand. On examining the swelling, pain was caused by pressure over the tumor, which was oval in shape, three inches above the wrist and in the line of the median nerve. There is no pulsation, the enlargement presented the characteristics of a cystic formation.

The tumor was exposed under local anæsthesia, the slightest manipulation causing great pain until the median nerve was blocked by an injection of cocaine solution. The nerve above and below the cyst was exposed, at the upper pole the nerve fibres divided and many could be traced running over the external surface of the cyst from which they were dissected. The patient, a sufferer from a severe form of cardiac disease, insisted that the operation should afford permanent relief from pain and that she felt unable to undergo another operation. It was therefore necessary to divide the remaining fibres, and thus remove the cyst. The loss of nerve tissue was too great to approximate the cut ends, although there were several fibres uniting the nerve.

BOOK REVIEWS

ANIMAL EXPERIMENTATION AND MEDICAL PROGRESS, by WILLIAM WILLIAMS KEEN, M D., LL D Boston and New York: Houghton Mifflin Company, octavo, pages 312

In this book are brought together the papers and addresses pertinent to the topic of the volume that have been made by the eminent author during the last thirty years, beginning with the address, *Our Debts to Vivisection*, which was made before the Woman's Medical College of Pennsylvania in March, 1885

To the book is added an Introduction by Ex-President Eliot of Harvard, which is practically a review of the book. As Dr. Eliot says:

"Dr Keen describes in this book, in a very interesting and convincing manner, the new surgery of the last forty years, and its extraordinarily beneficent results. He shows that the progress of surgery has taken effect in all parts of the human body, including the brain, spine, chest, stomach, intestines, liver, gall-bladder, appendix, pancreas, spleen and kidneys, and the arteries, veins and nerves; that many operations which were impossible or had a high mortality, before aseptic surgery was invented, have become not only possible, but safe, and that innumerable lives have been saved, and are continually being saved by operations new within forty years. He also demonstrates that the new surgery has reduced very much the period required for recovery, as well as the death rate, after a large variety of operations, such as those for compound fractures, ovariectomy, hernia, goitre, and the removal of cancers and tumors, and that the proportion of complete and rapid cure after operation has been greatly increased. He points out that lockjaw has been almost abolished, that the direct transfusion of blood has been achieved, that the mortality from diphtheria and cerebro-spinal meningitis has been greatly reduced, that yellow fever has been abolished as a destructive epidemic and that child-birth fever, formerly very destructive, has become rare

"The new surgery has been made possible by the combination of anæsthesia and asepticism, but asepticism owes to animal experimentation, guided and furthered by the new science and art of bacteriology, its origin and its successful application

The patient was entirely relieved of the pain, the nerve fibres which were preserved evidently supplied the thumb, for sensation partially persists here, but sensation and motion are lost in the second and third fingers

Pathological Examination—Specimen consists of a round cystic tumor measuring 3.5 by 3 cm. The wall of the cyst is 4 mm. in thickness, is white and fibrous in consistency. At one pole of the cyst a section of nerve is seen from which small fibrils radiate and spread out over the external surface of the cyst. The cyst is filled with a blood-tinged fluid, its wall is smooth and contains traces of brownish pigment.

On microscopic examination the cyst wall is composed of two layers, the outer consisting of bundles of hyaline fibrous connective tissue containing comparatively few cells and a few blood-vessels. The inner portion or that which corresponds to the lining of the cyst is composed of a very cellular tissue, many new blood-vessels, a small amount of fibrous tissue and traces of blood pigment. The appearance resembles granulation tissue. Sections stained by Weigert's method do not reveal any nerve tissue in the inner portion of the cyst wall, but show remnants of nerve fibres attached to the external coat. The nerves are surrounded by a considerable amount of fibrous tissue and are the seat of degenerative changes.

The diagnosis of a blood cyst in the substance of the median nerve can be made from the above findings. This condition seems exceedingly uncommon as no mention of it is made in numerous text-books. It was unfortunate that the relief of pain was the chief indication for operation, as preservation of sensation and motion might have been maintained by less radical measures.

BOOK REVIEWS

COLLECTED PAPERS BY THE STAFF OF ST. MARY'S HOSPITAL, MAYO CLINIC, ROCHESTER, MINNESOTA W. B. Saunders Co., Philadelphia and London Volume for 1913

The annual publication of a volume of papers from the Mayo Clinic is very properly looked forward to with much interest by the medical profession of this country. The book is made up of the publications which have originated at the clinic in Rochester during the year. It represents work accomplished. In the present issue 300 pages, or more than one-third of the whole volume, are devoted to the alimentary canal, 136 pages are devoted to the urino-genital organs; and over 100 pages to the ductless glands. A detailed analysis or report of such a varied collection of papers is impossible. The purpose of this notice of the publication of this volume from the Rochester Clinic is to call attention to the splendid work that is being recorded from this great institution. The recently proposed intimate relationship between the Medical Department of the University of Minnesota and the Rochester Clinic must add emphasis to the important place which this clinic holds in medical education in this country. This volume should be consulted by those wishing to know of the activity of this clinic and by those desirous of keeping in touch with the latest advance in surgical therapeutics.

CHARLES L. SCUDDER

ABDOMINAL OPERATIONS By SIR BERKELEY MOYNIHAN, M.S. (London), F.R.C.S., Leeds, England. Third Edition. Two octavo volumes. 980 pages, 371 illustrations (5 in color). Philadelphia and London. W. B. Saunders Company, 1914.

Moynihan's book is to be considered as a monograph upon surgical procedures which he himself puts into practice. He does not attempt to review the work of others, or to incorporate in his observations the various steps in technic which they advocate. While this course seems to present some disadvantages, still it enables one to form a good judgment as to the surgical work of the author.

It is to be remarked that there are no gynæcological operations described, only those have been included which are common to the two sexes. Also, the surgery of the organs which are partly intraperitoneal and partly extraperitoneal, such as the kidney and bladder, he has not considered, nor are the operations for the various types of hernia included. Most of the work is taken up in the depiction and description of those intra-abdominal operations which are most commonly used and which will be of most benefit to those reading the book,

"The immense benefits which modern surgery and serum-therapy have conferred on mankind are therefore due to animal experimentation"

The opinion and judgment of such a man as Dr Eliot must carry with it a great deal of weight. It brings much encouragement and hope to the scientific surgeon of the present day in the midst of the great cloud of opposition and obloquy, of sentimental misrepresentation and exaggeration in which the subject of animal vivisection is annually involved through the efforts which are made by the so-called anti-vivisectionists with every recurring session of our State Legislatures to secure the passage of legislation tending to hamper legitimate, scientific investigation.

Dr Keen, however, needs no authority to vouch for him. His own eminence as an educator, as a public spirited citizen and a practical surgeon is sufficient to give the greatest possible weight to his statements and opinions.

The volume, which is the result of the gathering together of the various addresses which he has made on the subject of animal experimentation during so many years, is one of the highest value as a handbook from which every one may draw authoritative statements on every conceivable phase of the question. The unreasonableness, inaccuracy and indifference to truth manifested by the opposition to animal experimentation are repeatedly exposed in these pages, and no one with an open mind can read its pages without a conviction as to the peculiar obliquity with which certain minds are sometimes seized when they approach questions with regard to which they are prejudiced, and of which they have little practical knowledge.

We commend this volume to every one who, either as a scientist or a philanthropist, is interested in the welfare of mankind. Especially should it be in the hands of every legislator to whom these questions come for ultimate action in the way of legislation, and also in every newspaper office from whence must come those published statements that mould so powerfully public opinion. With regard to the merit of the question, one can have but little doubt as to the ultimate result. "Truth is mighty and will prevail" is as true in the domain of animal experimentation as in any other department of life. Should there be at any time the temporary success of ill-advised and hysterical sentiment, the philosopher has but to bend his head to the storm and await the time, which will not be long delayed, when reason shall resume its sway.

LEWIS STEPHEN PILCHER

without confusing them with a mass of detail, relative to the care of conditions in which particular or special methods of operative conduct must be instituted

Mr Moynihan has reached the conclusion that any detailed reference to mechanical appliances for intestinal anastomoses may well be omitted, as he considers "all use of the button and bobbin to have served its purpose, and that their interest now is only historical" There are some, we feel sure, who will take exception to such a statement as this, and believe that there are occasions which arise in which the institution of either is most applicable and efficacious

The present edition is divided into two volumes—the first of which is subdivided into three sections, taking up General Considerations, such as, the necessary preparation for abdominal operations and the technic of the operation itself, the after-treatment of the patient, the various incisions, the treatment of wounds of the abdomen, acute and tubercular peritonitis, subphrenic abscess and the surgical treatment of visceral prolapse

Many of the observations in these chapters, especially in that chapter devoted to the preparation and after-treatment of the patient, are of great interest The method of the anoci-association and nerve blocking is thoroughly developed, and we note the incorporation of some dietetic rules which have lately been found to give the patients after operation much greater comfort

The author's method of early removal of intra-abdominal drains and his reason for his procedure, are very important and are to be carefully noted His only reference to the treatment of post-operative intestinal paresis is the administration of infundibula extract It might have been well to have mentioned some of the other methods which are employed, particularly where one is not in a position to obtain this agent

Section Two deals with the operations upon the stomach, and is complete and exhaustive The author's extraordinary experience in this class of cases leads him to lay down rather dogmatic rules which he has found essential to his success

The Third Section of the first volume takes up the various operations upon the intestines, which consideration is continued in the first part of the second volume, which is also an exhaustive monograph upon the subject and many original observations are to be noted

The author has had prepared with great care a large number of illustrations showing the various methods of suturing of the gut under varying conditions, which are most instructive and easily comprehended

CORRESPONDENCE

A LEAD PROTECTOR FOR USE IN BONE WORK

EVERYONE who has had experience in bone surgery has found some difficulty in avoiding accidents on account of the drills or bone saws, especially the latter, getting caught in the towels, sheets, or gauze drapes

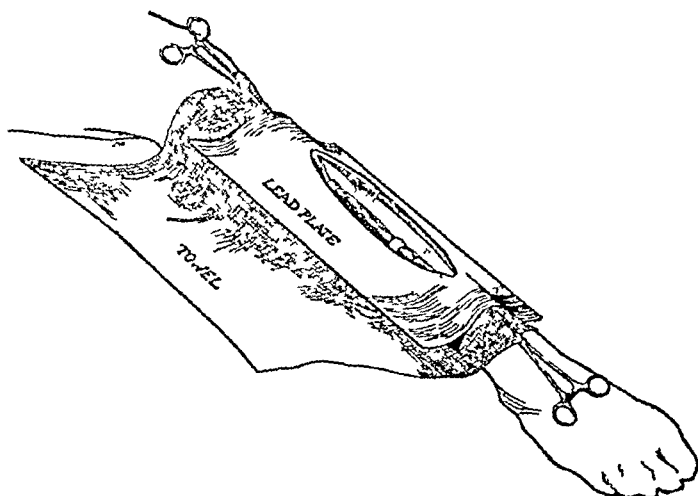


FIG 1 —Use of lead protector in bone work

which are used about the wound To avoid these accidents I have used the plan illustrated (Fig 1) A thin sheet of sterilized lead plate with a fenestrum of appropriate dimensions is laid over the operative field

Minneapolis, Minn

R E FARR, M D

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TO THE ANNALS *of* SURGERY VOLUMES FIFTY-ONE TO SIXTY

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NEPHROLITHIASIS

The case was regarded as one of hydronephrosis, and on October 5, Dr Eliot made the usual lumbar incision on the right side, and found the peritoneum extending laterally in the region usually occupied by the kidney. As far as the bodies of the vertebræ no kidney could be felt, and the upper part of the mass, on opening the peritoneum, was found to be a large projecting lobe of the liver. Through this opening the gall-bladder was explored, showing no evidence of cholelithiasis. The peritoneum closed, incision was extended downward and forward, and at the crest of the ilium the upper limit of the hydronephrotic sac was encountered. Its sac was closely adherent to the perirenal tissue, and at one point it was so thin that it ruptured during the manipulations.

The entire cyst, together with the kidney, was removed, and the wound closed with a cigarette drain.

The two interesting features of the case were, first, the fact that the hydronephrosis was associated with a Riedel's lobe of the liver, which obscured the diagnosis, second, the question as to whether the hydronephrosis involved a displaced kidney or a dystopia (unascended) of the kidney. The fact that the renal vessels ran downward and forward from their normal origin in the aorta indicated that the kidney had been displaced downward and that it was not a true case of *dystopia renalis*, in which the renal artery usually rises from the lower aorta or common iliac trunk.

The patient made a satisfactory recovery from the operation and had been free from symptoms since.

NEPHROLITHIASIS

DR ELIOT presented an Italian boy, nine years old, who was admitted to the Presbyterian Hospital on November 9, 1914, with the history that for the past six months he had suffered from daily attacks of general abdominal pain, sharp and sudden in onset, lasting from twenty minutes to one hour and becoming localized in the hypogastric region. At times, these attacks were associated with hæmaturia and followed by nausea, vomiting, chills and fever. The attacks usually came on during the act of micturition, the pain being cramp-like and so severe that it doubled the patient up. At times the pain occurred when he made a sudden movement and it was often quickly relieved by lying on his stomach. The last attack had occurred about one month ago. He gave a history of four severe attacks of hæmaturia, passing a large amount of bright red blood which left a heavy sediment in the vessel. The passage of blood did not increase nor lessen the pain.

Past history. It was learned, on inquiry, that the boy had suffered

removal of a chief tubercular focus allowed nature to care for the remainder. The patient's general nutrition, etc., then required careful supervision, as in dealing with tuberculosis elsewhere in the body. In some of his cases he had removed the entire ureter by Dr. Lihenthal's method, which he considered a very excellent one.

AN UNUSUAL CASE OF HYDRONEPHROSIS

DR. ELLSWORTH ELIOT presented a woman, forty-three years old, who was admitted to the Presbyterian Hospital on October 2, 1914, and who complained of sudden attacks of sharp, stabbing pain in the right, upper quadrant of the abdomen, persisting for two or three days and then subsiding quickly, leaving a soreness of the right flank. These attacks were not associated with chills, fever, headache, nausea nor vomiting. The first attack occurred ten years ago, and came on suddenly while the patient was stooping, since then the attacks had recurred at intervals of from one to five months, and she had had two attacks since January, 1914, the last one being more severe than the others and confining her to bed for ten days. The pain, which was sudden, usually came on during some bodily exertion and was localized on the right side of the abdomen. It was aggravated by bending forward, and was eased by lying quietly in bed with hot applications to the side. It usually subsided quickly.

The patient's urination during the course of these attacks showed no change. She usually voided urine three or four times daily and gave no history of the sudden passage of large quantities of urine nor burning during the act of micturition. The urine was of normal amber color, acid, with a specific gravity of 1020, it was free from albumin and contained a few epithelial and white blood-cells. The patient's menstrual history was negative. She showed a tendency to constipation.

Cystoscopy (by Dr. A. T. Osgood). The bladder held 300 cc without pain. The vesical mucous membrane was normal in appearance. The right ureteral orifice was small and catheterized with difficulty and the catheter was obstructed 20 cm. from the ureteral orifice. No urine was secreted from this side during the fifteen minutes that it was observed. The left ureter was secreting normally.

At the time of the patient's admission to the hospital examination revealed a tumor the size of a football extending from the free costal margin on the right side down into the iliac fossa. It was smooth, oval and elastic, readily palpable, with a slight depression near its upper limit.

GASTROPTOSIS WITH PERSISTENT VOMITING

ments On admission, the boy's temperature was 100.8° ; pulse 124, respirations 32. A blood count showed 22,600 white cells, with 91 per cent of polynuclears.

When Dr Eliot saw the patient he was lying sleeping without anodyne on his right side with his knees flexed, and apparently free from pain. Changing his position from the right to the left side gave rise to pain. In the right lower quadrant there was a mass which, together with the increased leucocytosis, gave rise to the suspicion of an appendicular abscess. The possibility of an intussusception was considered, but discarded. A gridiron incision was made, and upon exposing the peritoneal cavity a good-sized irreducible intussusception was found. It was limited to the lower part of the small intestine, with its apex within an inch or two of the cæcum. The gut was resected and an end-to-end anastomosis was done. The patient left the hospital on the thirteenth day.

The specimen showed necrosis of the inner sheath. An inverted Meckel's diverticulum had formed the apex of the intussusception.

Dr Eliot said that several years ago he had collated all the reported cases of this particular variety of intussusception, and in every instance the clinical symptoms were very severe, and most of the patients succumbed. In the case he reported to-night both the subjective and objective symptoms were very mild. The former in the infrequency of the vomiting, the freedom from severe and constant pain, the fact that sleep was possible without a narcotic, and that movement of the body could easily be carried out without marked discomfort to the patient. The latter in the complete absence of muscular rigidity and of marked tenderness over the tumor, which was larger and more oval than the tumor usually observed in enteric intussusception.

The absence of mucus and blood in the stools is the rule rather than the exception in intussusception above the ileo-cæcal valve. In the present case there was no sign of blood whatsoever in the intestine below the apex of the intussusception.

GASTROPTOSIS WITH PERSISTENT VOMITING

DR WILLIAM A. DOWNES said that in presenting this case he wished to call attention to the fact that simple ligature of the pylorus was some times followed by permanent closure and to invite discussion on the subject of gastroptosis. The patient was a girl of twenty who was admitted to the medical service of St. Luke's Hospital, on July 18, 1912, with a diagnosis of catarrhal jaundice, for which she was given the usual medical treatment, and she was discharged on September 6, improved.

from frequent nose bleeds and that he bled freely when cut. His mother, uncle, grandfather and half-sister also bled easily.

On admission, the patient's temperature was 98.2° , pulse 96, respirations 22. A blood count showed 15,200 white cells, with 71 per cent of polynuclears. The blood began to coagulate in 3.5 minutes and coagulation was completed in 11 minutes. The urine was acid, with a specific gravity of 1.028, it was free from albumin and red blood-cells. The Wassermann was negative. The X-ray showed a calculus in the left kidney pelvis.

Through a lumbar incision the left kidney was exposed and enucleated, and upon dividing the posterior wall of the pelvis, the calculus was readily found and evacuated. The wound was then closed with ordinary catgut and a cigarette drain left in for 36 hours. For seven days after the operation, the temperature ran the usual course, and then suddenly went up to 104° . It remained irregularly high for five days and then quickly fell to normal and remained so. During this period there were no evidences of wound infection, but a steady discharge of considerable quantities of blood in the urine. Coincident with the drop in the temperature the hæmaturia ceased and has not recurred since. At the time of the operation no damage had been done to the kidney, and the posterior wall of the renal pelvis was divided and sutured without hemorrhage. The case is presented as one in which the post-operative hæmaturia with the associated temperature might be ascribed to a hæmophilic diathesis.

The calculus which was removed from the kidney pelvis was about the size of a walnut and was composed of uric acid, calcium urate, and calcium oxalate.

INTUSSUSCEPTION IN A CHILD

DR ELIOT presented a boy, seven years old, who was admitted to the Presbyterian Hospital on October 12, 1914, with the history that at six o'clock on the morning of that day he was seized with a sudden, severe, cramp-like pain on the right side of the abdomen, with vomiting and obstipation. The vomiting recurred four times, the vomitus being fluid in character, bitter, without foul odor. There had been normal bowel movements up to the onset of the pain, the last one having occurred on the previous afternoon, since then there had been no passage of fecal matter nor flatus. He had never passed any blood.

The pain gradually subsided, leaving a sense of soreness in the right lower quadrant, which was eased by lying on the stomach or on the right side with the knees flexed, and was increased by body move-

TWO-STAGE PYLORECTOMY FOR ULCER

the gastro-enterostomy opening, no bismuth passing through the occluded pylorus. After considerable deliberation an exploration was decided upon. The anastomosis was found to be in good condition, both branches of the intestine were normal in appearance and there was no distention of the proximal loop. However, it seemed reasonable to do an entero-anastomosis. The proximal limb of the jejunum was too short to allow sutures to be used without considerable difficulty; therefore, an anastomosis was made with a Murphy button, the halves being introduced into each limb of the gut through an incision in the anterior wall of the stomach. An examination of the pylorus both externally and through the stomach incision showed the occlusion to be absolutely perfect, this was eight months after the ligature had been placed around it.

The patient made an uneventful operative recovery and remained free from vomiting until about a month ago, since then the regurgitation had recurred to a moderate extent. Still, her general health was much better and her gain in weight had continued. *An X-ray examination made in November, 1914, seventeen months after the occlusion of the pylorus, showed that the latter still remained closed and that all the bismuth passed through the gastro-enterostomy stoma.*

CASES OF TWO-STAGE PYLORECTOMY FOR ULCER

DR HOWARD LILIENTHAL presented two patients upon whom he had done pylorectomy in two stages in order to illustrate the importance of removing the pylorus in cases of ulcer in the pyloric area, whether on the gastric or duodenal side. The wisdom of this procedure had been impressed upon him by his observation of two cases in which the pylorus had been left behind after a gastro-enterostomy in one instance and a Finney's operation in another. It subsequently became the site of malignant disease several years after the primary operation, in one of the cases four or five years had elapsed. He believed, with Rodman, that the safest thing to do was to get rid of the ulcer-bearing area—not simply tying it off, but taking it out altogether. The operation should preferably be done in two stages, and the technic he employed was as follows.

When he was fairly certain of his diagnosis, he made his primary incision to the left of the umbilicus and completed the first stage of the operation—the gastrojejunosomy. Then, after an interval of four weeks, during the course of which the hospital patient may even be allowed to go home, the second stage of the operation is done through an incision directly over the disease and the pylorus can usually

She was readmitted to the surgical service of the hospital on April 5, 1913, complaining of vomiting after meals and with the history that since her discharge from the medical service she had suffered from epigastric pain which radiated to the left shoulder and was relieved by vomiting. There was no blood in the vomitus or stool. At this time the patient was slightly jaundiced, and an X-ray examination showed a marked degree of gastric ptosis, with considerable retention of food at the end of six hours.

On April 9, 1913, an exploration was made through an upper right rectus incision with negative result in so far as the presence of ulcer or gall-stones was concerned. The stomach and colon were elevated and fixed somewhat after the Coffey method, and the patient was discharged, improved, on May 24.

She was readmitted to the surgical service on June 25, and assigned to Dr. Downes, with symptoms similar to those complained of at the time of her previous admission. Since her discharge about one month ago she had lost considerable weight and had suffered from almost persistent vomiting, together with epigastric pain and marked constipation. Medical treatment and lavage had been tried without benefit. An X-ray examination at this time showed the stomach to be in the same position as it was previous to the gastropexy, with marked retention at the end of six hours.

On June 27, 1913, a second operation was done. The stomach was found to be markedly dilated and the pylorus was slightly thickened, but would admit the tip of the finger. With the exception of a few adhesions, there was no evidence of the previous operation. A posterior gastro-enterostomy was done and the pylorus was occluded by means of a heavy linen ligature. A few interrupted sutures were taken to unite the peritoneum across the groove formed by the ligature.

After this operation the vomiting ceased immediately and the patient made a good operative recovery. An X-ray examination, made a fortnight later, gave evidence that the food was passing rapidly through the stoma and that none of the bismuth was passing through the pylorus. The stomach emptied itself at the end of five hours.

On February 17, 1914, the patient was again admitted to the hospital with the history of regurgitation. However, she had gained some ten or twelve pounds in weight and was in better health than she had been for a long time. At this time she complained of pain in the left hypochondrium and said that the vomitus was greenish in color and usually occurred before breakfast. An X-ray examination showed that the stomach was emptying itself in about the normal time through

MESENTERIC CYST

DUODENAL ULCER GASTRO-ENTEROSTOMY PYLORIC EXCLUSION

DR MEYER presented a man, sixty-three years old, who came under his observation in the latter part of March, 1914, with the history that he had suddenly vomited large quantities of blood. He was removed to the hospital, and after a course of rectal and later duodenal feeding his condition improved sufficiently to permit of operation. All tests made pointed to pyloric or duodenal ulcer. On April 8, Dr Meyer opened the abdomen and found on the distal side of the pylorus a distinct infiltrated area. There was a series of adhesions between the posterior wall of the stomach and the transverse colon these were released, and after removing the appendix, which the speaker said he strongly favored in all these cases, he did a posterior gastro-enterostomy and excluded the pylorus by the silk-thread method. By making our way posterior to the stomach, we are able to pass a pretty strong silk suture, and then, by infolding the anterior gastric wall this can be drawn sufficiently tight to exclude the pylorus without unduly constricting the tissues. The patient made an uneventful recovery and is now enjoying excellent health.

What shall we do, Dr Meyer asked, in those cases where we have had severe hemorrhages from the stomach, without, perhaps, any tangible evidence of an ulcer on inspection and palpation during operation? In spite of the lack of such evidence the speaker said he was in favor of doing a posterior gastro-enterostomy and exclusion of the pylorus with appendectomy in cases where the laboratory and X-ray tests and the other methods now at our disposal for establishing the diagnosis of *ulcer near or at the pylorus* pointed to the presence of such an ulcer.

MESENTERIC CYST

DR CHARLES N DOWD presented a boy of seven years who was admitted to the Roosevelt Hospital on October 20, 1914. He had been in fairly good health until last summer, when he began to complain of an intermittent, dull pain in the abdomen, which was not colicky in character at any time. There was no history of constipation, but he had lost five pounds in weight since September 6. His parents stated that during the past two years he had not been as strong as formerly. Recently, on two occasions, he had vomited.

On examination, a mass, the size of an adult fist, could be felt in the lower part of the abdomen. It usually lay below and to the right of the umbilicus but could be displaced upward to the right costal border and over to the left lower quadrant. It had a globular feel and was not tender.

be removed at this time with much less difficulty than it could have been at the primary operation. There are no adhesions, the health of the patient has usually improved, and frequently pathological conditions that were met with at the first operation have disappeared, but a pylorotomy should be done nevertheless.

GASTROSTOMY AND INFERIOR ŒSOPHAGOPLASTY (BECK-JIANU)

DR WILLY MEYER presented an Italian woman, twenty-seven years old, who five months ago began to experience difficulty in swallowing, and examination revealed an Œsophageal obstruction 22 cm from the teeth-line. This was also shown by the X-ray. A small piece of the growth was removed by Œsophagoscopy, and pathological examination proved it to be malignant.

The youth of the patient in this case, Dr Meyer said, prompted him to attempt a radical operation with additional Œsophagoplasty. He made an incision through the rectus muscle as close to the median line as possible, and as the stomach proved to be fairly large, he did the typical Beck-Jianu operation. After ligation of part of the omentum, the major curvature of the stomach was exposed to within about an inch and a half of the pylorus. The stomach was then drawn forward and incised parallel with the greater curvature. Hueltl's stitching instrument was used. After division a running suture was placed on top. He now had a tube made from the lower part of the stomach, which was 22 cm long. With the stomach turned and the tubes drawn upward, the upper end of this lower portion of the new Œsophagus reached to the clavicle. It passed upward through a subcutaneous tunnel. In making this tube, care should be taken to make the communication with the cardiac end of the stomach small, otherwise, regurgitation might occur. Another precaution was to cauterize the superficially situated branches of the pneumogastric nerves at the base of the new tube, anteriorly as well as posteriorly.

Dr Meyer said he hoped to do a second operation on this patient, when he would attack the Œsophagus, excising the cancerous section and reforming a new Œsophagus, antethoracically, by means of the proximal portion of the divided Œsophagus and the new tube of stomach tissue that was now at his disposal. If he found himself unable to do a radical operation, he would try to divide the Œsophagus just above the aortic arch and bring its proximal end in connection with the upper end of the Beck-Jianu tube. This would permit the woman to again chew and swallow food, that means eat and drink, which was the one great desire of these patients.

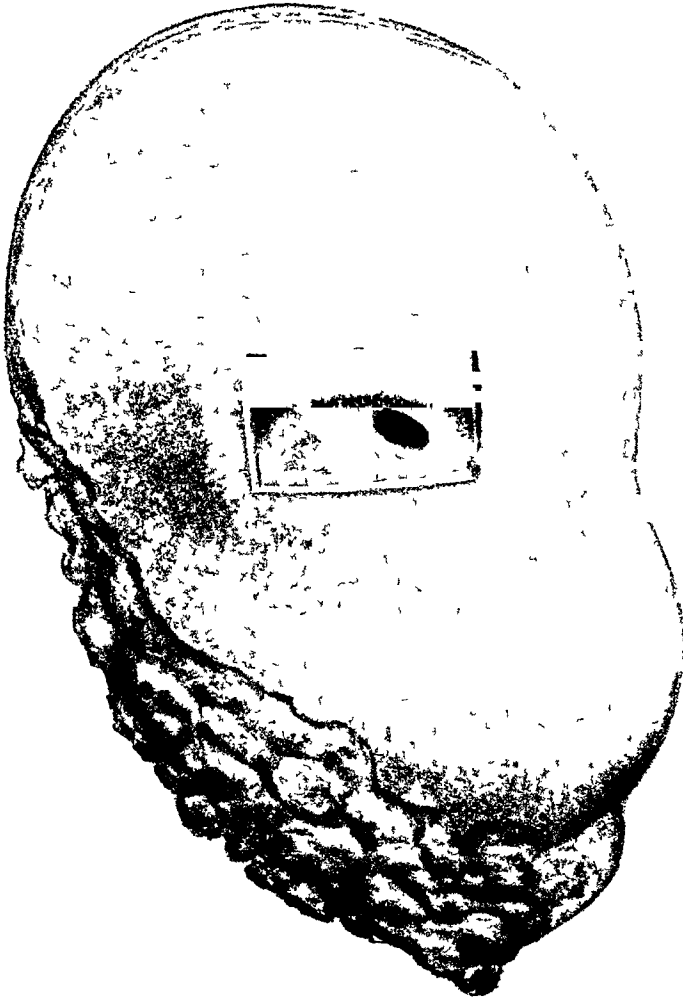


FIG 3—Mesenteric cyst The small locule contained clear serum, the larger one contained chylous fluid

On October 21 the mass was removed through a median incision. It was about three and a half inches in diameter and contained a large lobule which was sacculated and held five or six ounces of chylous fluid. There was also a smaller lobule containing clear serum. The cyst seemed to push forward from the root of the mesentery near the spine, and in this portion it contained fatty, fibrous and lymphatic tissue. The cyst wall was examined by Dr Baldwin Mann. It was found to be composed of fibrous tissue and showed no evidence of epithelium or endothelium on its inner surface. It seemed flattened out by pressure. The fluid from the cyst was examined by Dr J Greenwald of The Harriman Research Laboratory. It contained protein (calculated for nitrogen) 4.4 per cent, fat 31.8 per cent, and apparently chyle. The cyst was situated between the layers of the mesentery of the small intestine and had pressed on the intestine, so that it could not be removed without cutting some of the vessels at the mesenteric border. The patient made a good recovery, leaving the hospital twelve days after the operation.

Dr Dowd said this case was shown to illustrate a point which was called to the attention of the Society several years ago. It had been stated that these mesenteric cysts were caused by an occlusion of the lacteals, but there seemed no reason to believe that there was pressure enough to cause such a cyst formation even if the lacteals were obstructed. On the other hand, there was every reason to believe that these cysts came from some tissue which had the power of independent growth. The fact that in this case one lobule was filled with clear serous fluid and the other with chylous fluid was good evidence that the cyst formation did not come from occlusion of the lacteals, but rather from aberrant growth of some tissue, probably of embryonic origin. It was very important that the fluid content and the walls of these cysts should be examined whenever there was an opportunity.

SEPTIC MENINGITIS

Dr Dowd presented a girl, twelve years old, who entered St Mary's Hospital for Children on November 16, 1913, with discharging sinuses in her scalp leading down to necrotic areas in an osteoplastic skull flap. This flap had been raised in another hospital four months previously for the extraction of a bullet which had penetrated the left orbit and lodged in the right motor area.

As the necrotic spots in the bone were small and the sinuses short, healing was hoped for, and the wounds were dressed regularly for twenty-four days with apparent improvement. Her temperature then

INGUINAL HERNIA

suddenly rose to 104.6° , and she developed symptoms of meningitis, *i.e.*, rigidity of the neck, double Kernig sign, pupils slightly dilated, eccentric, but reacting to light, she was stuporous, complained of headache and had a disconnected idea of time

A lumbar puncture was done, which yielded about 45 c c of turbid fluid, under pressure. This fluid gave a marked sediment on standing, which showed 73 per cent. of polymorphonuclear leucocytes. No bacteria were found by culture or smear.

Operation showed a slight burrowing of pus outside the bone flap, and evidence of inflammation beneath it. The bone flap was removed and the wound widely drained. The patient was desperately ill for ten days, much of the time in so deep a stupor that she had to be fed through a stomach tube. Her temperature reached 104° or higher each day, the pulse ranged between 100 and 140. The neck remained stiff and she always gave a positive Kernig and a positive Janeway sign. Although she was in a stupor, she showed the characteristic irritability when disturbed. A second lumbar puncture, made three days after the rise in temperature, showed cloudy fluid from which *staphylococcus pyogenes aureus* was grown, and the same organism was seen in a smear from this fluid. Another lumbar puncture, taken seven days later, gave fluid less turbid and from which no bacterial growths could be obtained.

From this time on the patient steadily improved. The cranial defect had filled in satisfactorily, the hemiplegia from which she suffered had diminished, she had gained in weight and strength and was doing well in her studies.

This patient, Dr Dowd said, was shown to illustrate a recovery from septic meningitis, which was unusual. Neurologists tell us that these recoveries occur, but we do not see many of them. The case also serves as a striking illustration of a surgical principle that guides us in our every-day work, namely, the far-reaching effect of removing local infection. In this case the main infection was in the meninges of the motor area, while secondary infection had extended into the spinal canal, as was shown by the symptoms, the cloudy spinal fluid and the presence of bacteria, yet the patient mastered the secondary inflammation when the primary focus was removed.

INGUINAL HERNIA (NERVE DISTRIBUTION)

DR DOWD said that recently, when he called the attention of the Society to the iliohypogastric nerve, there seemed to be a general impression that the motor branches of this nerve were given off above the

PANCREATIC CYST

with as much care as they might have been, but at any rate he could not get any contraction

Dr. Moschcowitz said he had studied the distribution of this nerve as thoroughly as possible in various anatomies, these descriptions varied considerably and none of them appeared to be absolutely correct: in the best description he had found it was classified as a sensory nerve in that part of its course where it is exposed in an operation for inguinal hernia

Dr. ROBERT T. MORRIS said that since hearing Dr. Dowd's paper on the preservation of the iliohypogastric nerve in operating for the cure of inguinal hernia he had made some study of the condition in about ten cases and had found that the iliohypogastric nerve in this area was sometimes larger than the ilioinguinal

Dr. DOWD, in closing, said he was sorry that the results of the experiment made by Dr. Moschcowitz did not coincide with his own, which were carried out in five successive cases. With a small electrode he obtained very definite contractions, and in addition to the electrical tests, the microscopic examination of the sections gave confirmatory evidence, showing small but distinct branches emerging from the nerve trunk

In reply to Dr. Morris' observation, Dr. Dowd said the ilioinguinal nerve was usually larger than the iliohypogastric, but the former did not possess any motor function in that area

THE "TONGUE-DEPRESSOR" GASTRO-ENTEROSTOMY CLAMP

Dr. CHARLES L. GIBSON described this method and presented three patients upon whom it had been successfully used.

PANCREATIC CYST

Dr. BURTON LEE presented a married woman, aged thirty-nine years, who was admitted to the New York Hospital, in the service of Dr. C. L. Gibson, on May 8, 1914. Her family history was unimportant. Her past history showed a right-sided pleurisy thirteen years ago. Two years ago the patient had an attack of severe pain in the epigastrium, radiating to the left shoulder and back. She did not vomit and the pain lasted only about half an hour. A year later she had a similar attack but of longer duration. These attacks had since recurred at intervals of four or five weeks, always coming on soon after eating and relieved by self-induced vomiting. The vomitus had been brown, yellowish, greenish, and black.

The patient's present illness began five months ago, when she had

point where they could be injured in the operation for the cure of hernia. At that time he had already had dissections made and had consulted anatomists, and was confident that the nerve filaments were given off from the main nerve in such a way as to be impaired if the nerve was cut in the operative field.

Two other methods of study were available. One, the electrical stimulation of the nerve, the other, the making of serial microscopic sections across the nerve area. The first method was used on the patient he showed to-night and on four other consecutive hernia patients during their operations. One faradic electrode was placed behind the pelvic crest and the other small electrode was sterilized and applied to various spots on the internal oblique muscle and its nerves after the aponeurosis of the external oblique had been split and laid open. It was interesting to see the local action that could thus be obtained. When the electrode was applied well up toward the anterior superior iliac spine, a local contraction of considerable extent followed, when it was applied further down, a smaller local contraction resulted close to the point of contact. When the nerve was touched as it crossed the operative field, a contraction was obtained of those muscular fibres which ran toward the conjoined tendon. When a part of the nerve was raised from the muscle and laid over a piece of dry gauze and then stimulated by two sterile electrodes applied to this isolated section, a similar local reaction occurred.

Dr Dowd said he then excised the lower portion of some iliohypogastric nerves, together with the muscle tissue in which they lay, and had serial sections cut from various portions of these specimens. In this way the nerve filaments could be seen running between the muscle bundles after separating from the main nerve trunk.

These two observations, the speaker thought, together with the dissections, seemed to him to prove conclusively that fibres are given off by this nerve within the operative field and that these fibres run to tissues which are important in the repair of hernia.

Dr MOSCOWITZ said that within a day or two, while operating on a case of inguinal hernia, he tested electrically the iliohypogastric nerve for muscular distribution, and he had to confess that his results were somewhat different from those reported by Dr Dowd. He made his experiment as follows. He exposed the iliohypogastric by careful dissection and raised it from the muscle for a distance of one centimetre. Under this he slipped a piece of perfectly dry rubber tissue. He then tested the nerve with first a mild, then a medium, and finally a strong faradic current, and in no instance was there a resulting muscular contraction. Perhaps his experiments were not carried out

SUBCUTANEOUS RUPTURE OF THE JEJUNUM

dition at this time was markedly improved she was free from pain, her appetite was good and she was gaining in weight and strength. At the present time the patient was apparently in good health and her appetite was excellent. At times she had a little burning and distress in the epigastric region, but not enough to give her serious discomfort. Pathological examination of the fluid evacuated from the cyst showed a growth typical of the staphylococcus albus.

DR WILLIAM A. DOWNES mentioned a case where after opening the abdomen and removing a large number of gall-stones he noticed that the pyloric end of the stomach was unduly prominent, and upon investigation a distinct fluctuating mass was discovered which proved to be a pancreatic cyst lying between the stomach and colon. It contained about one pint of fluid. Nothing in the history had suggested this condition and as the patient was quite stout it was not felt upon palpation.

SUBCUTANEOUS RUPTURE OF THE JEJUNUM

DR LEE presented a man, forty-five years old, who was brought to the Hudson Street Hospital on October 26, 1914, and admitted to the service of Dr. Francis Murray. The history obtained was that about three-quarters of an hour before his admission he was struck over the lower abdomen by an oak slab, about one foot long and four or five inches thick. The blow was delivered with great force, the slab having been caught in a revolving saw and hurled with tremendous velocity. It struck the man in the lower abdomen, knocking him prone to the floor.

When examined on admission, he appeared to be in great pain and somewhat shocked. He was trembling, very pale, with a pulse of 100 and feeble. His temperature was 99°. The pupils were somewhat dilated. The breathing was entirely thoracic. Examination of the abdomen showed generalized board-like rigidity, and pressure elicited exquisite tenderness most marked just above and to the right of the umbilicus. Percussion gave a small area of dulness low down in both flanks. The patient was catheterized, and six ounces of perfectly normal urine were withdrawn.

An immediate exploratory laparotomy was done by Dr. Lee through a long right rectus incision, and, upon entering the peritoneal cavity, a quantity of bloody fluid and a number of blood clots were found. Search revealed a rupture of the small intestine, probably the jejunum. The rupture was transverse and involved at least three-quarters of the lumen of the intestine. The mesentery in the region of the rupture

an attack which confined her to bed for a week. The pain was then in the epigastrium, radiating to the left axilla and back. She vomited repeatedly but apparently made a complete recovery in the course of a week. A month ago she was admitted to the medical side of the hospital with a similar attack. A diagnosis of left pleurisy, with effusion, was made. Aspiration was performed, and 200 c c of fluid was evacuated. The patient was greatly relieved, but still complained of epigastric pain. A test meal, taken on April 30, showed free hydrochloric acid 48.3, with a total acidity of 68.3. The fasting stomach contents gave free hydrochloric acid 12, total acidity 32. Eight days before her admission to the surgical side of the hospital she complained of severe pain in the right hypochondrium, shoulder, back and right lower quadrant. There was quite severe pain and tenderness in the right hypochondrium. She vomited many times, the vomitus being yellow and green. Physical examination showed a normal thorax. The abdomen was not rigid, but there was tenderness on deep pressure in the right hypochondrium, in the anterior axillary line and in the epigastrium. No masses were made out.

Operation, May 15, 1914, by Dr. Lee. With the patient in the dorsal position an incision four inches long was made over the right rectus in the gall-bladder region, and, upon exposing the peritoneal cavity, the gall-bladder was readily found. It was apparently normal, without stones or adhesions, and could be readily emptied. The stomach showed nothing abnormal. Upon passing the hand to the left, however, a rounded, fluctuating mass could be felt. It appeared to be cystic and was situated well to the left side. A second incision, five inches long, was made through the left rectus, and an effort was made to reach the mass through the gastrohepatic omentum, but this proved unsuccessful. The gastrohepatic omentum was then pulled upward and an opening made into the mesocolon posteriorly, and the mass readily exposed. It was reddish in appearance, with grayish patches. A small needle was inserted into it, withdrawing a non-purulent, serous fluid, which was removed with the sucker. The last part of the contents of the cyst was a little more turbid and somewhat purulent. The mass was regarded as either a subphrenic purulent accumulation or a pancreatic cyst, with subsequent abscess formation. A cigarette drain was passed into the cyst cavity and then through the great omentum just below the stomach, emerging from the upper angle of the wound. The wound was closed in layers with chromic catgut, with interrupted silkworm gut for the skin. The patient's convalescence was uneventful, and she was discharged on June 19, 1914. Her con-

ligament begins at the navel, leaving the cephalad end attached, and this gives five inches of lining ligature larger than a lead pencil in diameter

DR GEORGE A. WOOLSEY said that von Eiselberg's statistics were rather noteworthy in that his cases of exclusion of the pylorus gave a considerably larger proportion of peptic ulcers of the jejunum than cases with gastro-enterostomy without exclusion. There were cases, undoubtedly, where exclusion was a valuable adjunct to the operation, and the speaker said he did not think we should overlook von Eiselberg's original idea in introducing it for certain cases of gastric carcinoma. In cases of carcinoma of the stomach not suitable for partial gastrectomy the best thing we could do was unilateral pyloric exclusion and a Reichel or Polya or a simple gastro-enterostomy. The latter by itself was not of as much service as was desirable. If the ulcerated area in the stomach could be excluded, these patients were much more apt to improve, for their appetite and digestion were far better. Then too in suitable cases a second operation could be done, removing the carcinoma and making a two-stage gastrectomy with safety to the patient.

As to the technic of pyloric exclusion, Dr Woolsey said that in a recent case where he followed the Wilms method by the transplantation of a fascial flap, a subsequent X-ray did not indicate that perfect occlusion had been secured, nor did he think that was needed. It was not at all necessary for the occlusion to be water-tight. What was wanted was to rest that part of the alimentary tract and protect it from chemical and mechanical trauma, and an absolutely tight anatomical closure was not necessary.

DR GEORGE E. BREWER said he was firmly of the belief that pyloric closure was only indicated in a comparatively small number of cases, and in his own experience, particularly with duodenal ulcers, a simple gastro-enterostomy had given very satisfactory results. He could not, at the moment, recall a single case where exclusion of the pylorus would have been an added advantage.

In dealing with duodenal ulcers causing severe hemorrhage he thought it advisable to close the pylorus in addition to doing a gastro-enterostomy. He had had an opportunity of seeing von Eiselberg perform this operation by his method, and in that instance it took him a good deal longer to do the exclusion than the gastro-enterostomy. In patients who have suffered from recent severe hemorrhages from duodenal ulcers, time was a very important element, and for that reason he was in favor of simply infolding the tissues by a ligature over a metal band. He had tried this method seven or eight times on ani-

was contused and ecchymotic, and at another point lower down, the outer coat of the intestine showed the same condition. End-to-end anastomosis was performed by a running suture of Pagenstecher through all the coats, and then by a Cushing suture through the two outer coats, and, lastly, another Cushing suture was placed over the first, making good peritoneal approximation.

The blood clots were sponged from the peritoneal cavity and the free fluid removed by means of the sucker. The intestine was replaced, the peritoneum closed by a running suture of catgut, the muscles by interrupted sutures of chromic gut and the fascia by interrupted sutures of silkworm gut and by a running suture of catgut. No drain was used. Time of operation, 45 minutes. Hypodermoclysis was employed on the day of the operation, and four ounces of saline, with one drachm of glucose, were given by rectum daily until November 2, when he was put on fluid diet.

Three days after the operation and for two days following the patient had several attacks of hiccough which were relieved by lavage. Convalescence was otherwise uneventful save that there was a slight purulent discharge at the lower angle of the wound; this, however, was superficial, being confined to the subcutaneous tissue, and the wound closed completely on November 7, twelve days after the operation.

At the present time, December 9, 1914, the patient had a firm scar; there was no abdominal discomfort and the bowels were regular.

OCCLUSION OF THE PYLORUS

DR C. L. GIBSON and DR FLN WICK BEEKMAN read a paper with the above title, for which see page 423.

DR MORRIS said he wished to call attention to one point in connection with exclusion of the pylorus. If we tied a strong silk cord firmly around the lower part of the pylorus, sufficiently tight to cut the mucosa, we would have a subsequent scar that will assist in the contraction of the parts.

In doing this operation on the pylorus, Dr Morris said, the homoplastic flap was the one that had appealed to him. After the receipt of a copy of an abstract of Dr Gibson's paper a few days ago, he was called upon to do a gastro-enterostomy, and in the course of the operation he dissected out enough of the falciform ligament to permit him to make a turn and a half about the pylorus. This ligament carried its own blood supply and when twisted in this way about the pylorus it made a very firm, and, he hoped, permanent constriction. Dissection of the

MELANOSARCOMA OF THE UPPER JAW

articles referring to occlusion of the pylorus had recently come from the Mayo clinics

DR FREDERIC KAMMERER said he had operated by the von Eiselberg method in eight cases, with no mortality. He agreed with Dr Gibson that the operation occasionally proved a difficult one technically. In his own cases the gastro-enterostomy and exclusion usually occupied about an hour and a half, but he was unwilling to admit that this was about equivalent to a pylorectomy. In some of his cases, a pylorectomy would have been impossible, or would at least have proven a much more serious undertaking.

Speaking of bleeding ulcers of the duodenum, Dr Kammerer recalled the case of a young man upon whom he did the von Eiselberg operation after several hemorrhages. Four weeks after the operation the patient had another rather severe hemorrhage, showing that the von Eiselberg exclusion did not absolutely prevent such an occurrence. This patient later on developed a peptic ulcer, necessitating closure of the posterior gastro-enterostomy and the establishment of an anterior opening with an entero-enterostomy. He remained in a fairly comfortable condition for about six months, when he again began to complain of pain, which only large doses of bicarbonate of sodium would alleviate. His condition now was somewhat improved, but still the result, after one and a half years, was not satisfactory. One other case had complained of pain and general dyspeptic symptoms so persistently, that a second laparotomy was done without disclosing any cause for these symptoms. These dyspeptic symptoms have continued off and on (over two years) with intervals of perfect freedom for several months at a time. All the other cases have done well. The patients have increased in weight and were relieved of all their symptoms, when seen about six months ago.

Stated Meeting held January 13, 1915

The President, FREDERIC KAMMERER, M D, in the Chair

MELANOSARCOMA OF THE UPPER JAW

DR ALEXIS V MOSCHCOWITZ presented a child, whom, he said, he had presented at one of the previous meetings of this Society, under the title "Odontoma of the Upper Jaw." He now presented him again, for two reasons. First, in order to show the result of operation, and second, in order to correct an error in the histological diagnosis.

Operation was performed November 28, in the following manner, in ether anæsthesia, after a preliminary submucous infiltration with

mals, and in every instance it was successful and gave a perfect closure, without evidence of necrosis

DR H H LYLE said that Dr Kammerer at a previous meeting had shown X-ray plates of a stomach after the von Eiselberg operation. In these plates the lower angle to the stomach had tilted downward and formed a pouch whose level was below the gastro-enterostomy opening. Quite recently such a case had come to St Luke's Hospital with the diagnosis of ventral hernia. In repairing the hernia an examination of the stomach revealed the condition described by Dr Kammerer. The gastrohepatic ligament was shortened and the angle of the stomach restored to its normal level. The restoration of the level gave clinical relief and was demonstrated by X-ray examination.

Dr Lyle mentioned this case to call attention to the necessity of providing against the sagging of the pyloric end of the stomach.

DR A V MOSHCOWITZ said that exclusion of the pylorus was a matter of particular interest to the surgeon, on account of the frequency of operations on the stomach. There was scarcely an operating day that two or three such cases were not seen at Mt Sinai Hospital. Personally, the speaker said, he always tried to occlude the pylorus in every case where the ulcer was situated at the pylorus or in the first portion of the duodenum and where the pylorus was still patent.

As a matter of fact, no method of exclusion was perfect, not even the von Eiselberg. Some years ago, Dr Moschcowitz said, he showed the X-ray plates of a case where Dr Gerster had excluded the pylorus by the von Eiselberg method, and within a year after the operation bismuth was again seen passing through the pylorus. While the method suggested by Dr Gibson was an excellent one, no method could be claimed to be ideal, no more than a partial stenosis could be permanently expected, nor was anything more than this necessary. If we could exclude the pylorus for a certain length of time, our purpose would be served. The speaker said his own method could be applied in two minutes: he merely passes some sutures through the tissues and draws them tight, puckering them, so that the anterior wall is pressed against the posterior. Some of these cases had been examined under the fluoroscope as long as six months after the operation, and no bismuth was seen passing through the pylorus.

Dr Moschcowitz said he did not believe that much good could be expected from a simple gastro-enterostomy in ulcer of the stomach. Hartmann claimed that most of the food would pass through the new stoma providing it was made as close to the pylorus as possible. Several

PENETRATING ULCER OF STOMACH

attack of vomiting, which lasted for forty-eight hours, and which very probably was due to the ingestion of smuggled food

Patient was discharged November 20 He is now in perfect condition and has gained 10 pounds in weight

The pathological examination of the specimen showed a callous ulcer, no malignancy

EXCISION OF PENETRATING ULCER AT MIDDLE OF LESSER CURVATURE OF STOMACH

DR MOSHCOWITZ presented a man, fifty-eight years of age, who was admitted to Mt Sinai Hospital June 1, 1914 His history dates back over ten years, but his complaints have been particularly severe only during the past two years His chief complaints were pain in the epigastrium, which did not radiate, and which was relieved for a short time by the ingestion of food He was frequently awakened at night, at about 11 or 12 o'clock, with very severe attacks He vomited occasionally, but to his knowledge saw blood once only in the vomitus Has lost 45 pounds in weight during the past ten months

The physical examination was entirely negative Analysis of the stomach contents after an Ewald test breakfast showed a total acidity of 70, free HCl 20, lactic acid 0 The conclusions of the X-ray department read as follows "Both by repeated fluoroscopy, as well as on two plates taken at different times, a projection can be seen on the lesser curvature about its middle, which was taken to be a penetrating ulcer at that point"

Patient was operated upon June 6, through a median incision A large, hard, crater ulcer was felt at the middle of the lesser curvature The ulcer was excised, the bleeding vessels being caught and ligated as encountered While the excised specimen was very small, the resulting defect was very large After closure of this opening, it was seen that the stomach was so much deformed, that it was deemed wisest to add posterior reticocolic gastrojejunostomy by suture Duration of the operation one and one-half hours

For one week after the operation the patient vomited a great deal, requiring frequent lavage He refused all nourishment, so that he became even more emaciated than before, finally the vomiting ceased, and he made an excellent recovery

He now feels perfectly well in every respect, eats a liberal mixed diet, and has gained over forty pounds in weight Particular attention was called to the fact, that in spite of perfect primary union, there is a slight hernial bulging in the upper part of the wound, the reasons for so doing will become apparent in connection with the presentation of the next case

adrenalin The palatal mucosa was split over the greatest convexity of the tumor, and the greatest portion of the tumor shelled out with a periosteal elevator, its extension into the superior maxilla and antrum was removed by chisel and rongeur The specimen removed was dark, pigmented, and rather hard, it was, however, well circumscribed, and appeared to have a capsule The cavity was packed with iodoform gauze After the operation there was a sharp rise in the temperature, up to 105.4° F, but it soon dropped to normal after the removal of the packings The baby was discharged from the hospital in about two weeks time The cavity rapidly contracted, and is now completely healed

Dr F S Mandlebaum, Pathologist to Mt Sinai Hospital, after examining the specimen reported that it was a melanosarcoma

RESECTION OF PYLORUS AND ADJOINING PORTION OF STOMACH (ONE-HALF) FOR ULCER OF LESSER CURVATURE

DR MOSCHCOWITZ presented a man, forty-eight years of age, who was admitted to Mt Sinai Hospital October 23, 1914 His history dates back over five years, and his complaints were those of epigastric distress, cramp-like pains across the upper abdomen, and vomiting, the latter occurring usually within five to twenty minutes after the ingestion of food Has vomited visible blood only once, and as it happens on the date of admission He had been upon the medical service of the hospital six or seven months ago, and was treated for a gastric ulcer, however without any amelioration of his symptoms The pain now is very intense, and radiates to the left and back

The physical examination is negative, except for extreme tenderness in the epigastrium, to the left of the median line Examination of the stomach contents after an Ewald test breakfast showed a total acidity of 70, and free HCl 37

The conclusions of the X-ray department were the following "The condition is probably a gastric ulcer, and in view of the retention after six hours, probably pyloric in situation"

Patient was operated on October 28, 1914 A transverse incision was made through the left rectus Exploration revealed a hard mass, at about the middle of the lesser curvature, with its base posteriorly Many nodes were left along both curvatures Under the impression that he was dealing with a malignant neoplasm, resection of the distal portion of the stomach was performed

This patient also had a very stormy convalescence, there being a great deal of vomiting during the first week, requiring frequent lavage, and once again after convalescence had been established, there was an

LYMPHOSARCOMA TREATED BY MIXED TOXINS

and the abdomen rapidly closed by inadequate through-and-through sutures. The condition of the patient upon the operating table was desperate. Fair but not perfect primary union resulted.

Patient's bowels moved freely thereafter, but even now after complete recovery, the patient from time to time becomes bloated, and at such times requires heroic measures to overcome the distention.

Dr. Moschcowitz added that while it is true that such recognized authorities as Kocher, Patterson and others advocate merely a gastro-jejunostomy in all ulcers of the stomach, this method does not fully appeal to him. He had therefore treated all cases of ulcers of the stomach, wherever feasible, either by excision, or by gastro-enterostomy plus exclusion from the food current. As exclusion is not feasible in this location, he had sometimes stretched a point and carried out a rather difficult and dangerous operation, in order to do justice to the principles, as he had formulated them for himself. Fortunately he had not as yet to report any fatal issue. In a number of cases he could not do either for technical reasons, and was satisfied with a simple gastro-enterostomy, the results were fully satisfactory, but the time is too short as yet for a final judgment.

In connection with these cases he called attention to the transverse incision which he had used. The incision gives perfect exposure, intestines never tend to crowd into the incision, so that no retention packing is ever necessary. It takes a somewhat longer time to get into the abdomen, and a trifle longer also to get out, but the final result, as far as cicatrix and hernia are concerned, is ideal in every respect. The third case is of particular interest in this connection, because the incision had to be reopened and resutured three times, although the final suture was anything but adequate, the result leaves nothing to be desired.

LYMPHOSARCOMA TREATED BY MIXED TOXINS

DR. WILLIAM B. COLEY presented a patient who had been suffering with an inoperable lymphosarcoma of the neck, and had been successfully treated with the mixed toxins of erysipelas and bacillus prodigiosus.

The treatment was carried out for one year from the time it was first started. 121 injections being given in all. The last injection was administered on May 13, 1914, since which time he has received no toxins. His weight has increased from 186 to 206 pounds, and his general health has been excellent. There is no evidence of any tumors or enlarged glands at present one and a half years later.

EXCISION OF PENETRATING ULCER NEAR CARDIAC END OF
LESSER CURVATURE

DR MOSHCOWITZ presented a man, forty-one years of age, who was admitted to Mt Sinai Hospital November 19, 1914. His father died of a cancer of the liver, and his mother from some tumor of the spine. The patient's history dates back over fourteen years, when he was suffering from attacks of epigastric distress, nausea and pyrosis. This condition continued up to six years ago, when he began to complain of sharp pains, which came on about an hour after each meal, and, starting in the epigastrium, radiated to the left side of the abdomen, precordium, and left shoulder. These pains lasted for three-quarters of an hour, and very gradually subsided. There was extreme tenderness over the left hypochondrium.

Operation (November 25). Through a transverse incision through the left rectus, an indurated area was felt on the posterior surface of the stomach, near the cardiac end of the lesser curvature. Excision was decided upon, therefore the Sprengel incision was lengthened to the right. The ulcer, adherent to the pancreas, was dissected free and excised, the vessels being caught and ligated as encountered. The resulting defect was very large, in spite of the small size of the excised specimen, but was finally closed with a double row of sutures. The external wound was closed in layers. Duration of the operation one hour and thirty-five minutes.

Pathological diagnosis, callous ulcer of the stomach.

In the course of the afternoon of November 27, or forty-eight hours after operation, the patient vomited repeatedly small quantities of dark, foul-smelling fluid. In the evening a stomach tube was passed, and 34 ounces of a similar fluid withdrawn, followed by a lavage. Thereafter the stomach had to be washed repeatedly on account of the vomiting, anywhere from eight to forty ounces being withdrawn each time. The general condition of the patient rapidly deteriorated.

On December 5 the vomiting, which had ceased for two or three days, recommenced, and in addition there was also an obstinate constipation. It was decided to reopen the wound, in order to investigate the condition of the stomach. The following condition was found: Omentum and completely collapsed coils of small intestine were found adherent to the wound, so that the stomach was not even seen during this, the third operation. The collapsed intestine was traced back, until a point was reached, deep down in the pelvis, where it was constricted and angulated by a band, just beyond this constriction the intestines were enormously dilated. The constriction was liberated,

BILATERAL EXCLUSION AND OCCLUSION OF INTESTINE

MELANCHOLIA RELIEVED BY TREPHINING

DR ROBERT MORRIS presented a young woman, twenty years of age, who had received a simple depressed fracture of the right parietal bone ten years previously. Little significance had been attached to the depression which remained, although the patient sometimes had a feeling of discomfort in that region. Last spring she developed melancholia with destructive features, and had to be kept continually under guard. Her physician and Dr Morris were both impressed by the fact that the patient when moving aimlessly about had a tendency to place her hand at the site of the skull defect. Alienists who were consulted were much opposed to operation, but this was done at the Post Graduate Hospital in August last. The depressed area of skull was elevated, dural adhesions were separated, and a piece of Cargile membrane was introduced for the purpose of preventing recurrence of adhesion. The patient had begun to improve definitely about a week later, became entirely well, and had remained well up to the present time, with no evidence of psychosis remaining.

SKIN GRAFTING AFTER REMOVAL OF TATTOO MARKS

DR EDWARD M. FOOTE showed a patient from the back of whose hand he had removed a tattoo mark twenty months previously, immediately covering the raw surface with Thiersch grafts taken from the thigh. The tattoo marks were in the form of a square on the back of the hand, measuring about two inches on a side. Attempts had previously been made to obliterate them by chemicals and the result was a disfiguring scar with an abundance of red and blue pigment scattered over it.

Dr Foote dissected the skin of the entire area with scalpel and forceps, deep enough to remove all pigment. In a part of the wound area the whole thickness of skin was removed, in a part the lower portion of the derma was removed. The result of the skin grafting was a non-pigmented, movable and flexible skin, somewhat thinner than normal skin, closely resembling in appearance the skin of the aged.

BILATERAL EXCLUSION AND OCCLUSION OF THE INTESTINE

DR FREDERIC KAMMERER presented a man, who came under his care in 1895. During the course of that year he had been operated on several times for appendicitis, with the result that a fecal fistula had become established, through which a large part of the intestinal contents were discharged. In February, 1896, an attempt was made to close the

INOPERABLE INDURATED ULCER OF LESSER CURVATURE OF STOMACH JEJUNOSTOMY

DR HOWARD LILIENTHAL presented a man, forty-eight years old, who had been admitted to Bellevue Hospital on May 15, 1914. There had been pains in the stomach from one to three hours after meals during the last six years, the pain radiating to the back, and there were occasional remissions. There had also been loss of weight.

The patient had been operated upon in Roosevelt Hospital, and on communicating with that institution it was found that the diagnosis had been indurated ulcer of the posterior part of the stomach on the lesser curvature. Gastro-enterostomy had been performed but without relief.

The patient complained bitterly of the pain and was ready for any operative procedure.

Physical examination showed a fairly well-nourished man with a median laparotomy scar, no tenderness, no masses.

With the idea of testing the stomach Dr Lilienthal performed jejunostomy in local anæsthesia with novocaine, on March 26, 1914. Digital examination at this time confirmed the diagnosis of the gastric condition. There was now gradual improvement with gain of weight. Early in July stomach feedings supplementary to the jejunal ones were permitted and the gain in weight became more rapid, the appetite improved and the attacks of pain disappeared. At the earnest request of the patient the tube was left out and the jejunal opening closed spontaneously. The old pain, however, returned, and, on September 18, 1914, the patient was admitted to the Medical Side of Mt Sinai Hospital for duodenal feeding through a stomach tube, which it was hoped would find its way into the pylorus or stoma, the tube used being the narrow calibre one of the Einhorn duodenal bucket. The feedings were not satisfactorily carried out, but under careful medical supervision there was steady improvement and cessation of pain.

On December 5, 1914, in nitrous oxide and ether anæsthesia, there was an operation for indurated fistula *in ano* and the patient was discharged from the hospital about three weeks later.

While it is difficult to say which treatment or which operation contributed most to the relief of this case it was Dr Lilienthal's impression that these cases should all be treated by duodenal feeding through the mouth before any surgical procedure, except perhaps an exploration, should be undertaken. This case was presented because it was one of those in which Dr Peck would be personally interested since it was one of those on his list.

no mass beneath the scar was demonstrable on this occasion, the speaker again incised the loop but only succeeded in giving exit to a very small amount of liquid, foul-smelling material. The patient's convalescence was delayed on this occasion, but he gradually improved, although there was very little secretion from the opening. For the past ten years the fistula now and then opens, after it has been closed for weeks and even months, and at such times discharges small amounts of a mucous material for an indefinite period before again closing. During this time the patient has remained in good health and no untoward developments have necessitated further surgical interference. The patient refuses to entertain the suggestion of removal of the occluded loop.

The speaker said he knew of only one other case, which had been observed for a long period—that of Wiesinger (*Deutsche Zeitschrift fuer Chirurgie*, vol. 100). In this case the upper part of the ascending colon, the transverse and descending colon, and part of the sigmoid flexure were entirely excluded and occluded from the fecal circulation. The patient lived for 13 years, during which time she was able to work as a housekeeper and suffered only slight occasional inconvenience. She collapsed and died rather suddenly while at the hospital under Wiesinger's care. The autopsy showed that no communication between the excluded loop and the normal intestine had formed. The loop was filled with light-colored, liquid material without odor. There were several large ulcers in the mucosa, one of which, in the transverse colon, had perforated, allowing the escape of the greater part of the contents of the loop into the peritoneal cavity, causing the collapse and death of the patient. The other cases of total exclusion and occlusion had all been done for serious pathologic conditions in the intestine, which had caused the death of the patients before a sufficient length of time for observation had elapsed. Baracz had shown in his experimental work that coils of intestine, which had been entirely shut off for 400–500 days, at autopsy still contained a large amount of foul liquid material, which later on, as in Wiesinger's case, might have led to perforation with collapse or septic peritonitis. Several points the speaker thought had been conclusively proven by these experimental and clinical observations. In no case, whether we were dealing with a normal or diseased intestine, was it permissible to do an immediate total exclusion and occlusion. When a bilateral exclusion was done, a rather large opening in the excluded loop should exist, at least immediately after operation, for the escape of secretions, and, if

opening in the intestine, after extended dissection of the parts, which failed. On account of the dense adhesions found at this operation the speaker decided upon an intestinal anastomosis as the best means of relieving the condition. Some weeks later the ileum was divided about six inches from the ileocaecal valve, the distal end closed and the proximal end implanted into the middle of the transverse colon. (The case has been minutely described in the *Medical Record* of February 20, 1897 and July 1, 1899.) As a result of this operation by far the greater part of the fæces were evacuated by the anal route. A second attempt to close the fistula in the iliac region, made at this time, also failed. In December, 1896, the abdomen was, therefore, reopened, the transverse colon divided at a point immediately before the implantation of the ileum into it and the ends closed by suture. Thus six inches of the ileum, the entire ascending colon, and half of the transverse colon were entirely excluded from the fecal circulation, an outlet for the secretions of this part of the intestinal tract still existing in the large fistulous opening in the iliac region. Through this opening the intestinal wall formed a prolapse as large as a fist, which, however, was easily reducible. This, more than the secretions from the intestine, which had almost entirely ceased, was the cause of much annoyance to the patient. In August, 1897, the speaker, therefore, closed the large opening by careful dissection and suture. The wound healed completely and he was able to report, four years and eight months after this last operation (*Centralblatt fuer Chirurgie*, 1902, No. 19), that the patient had been in excellent health and had suffered not the slightest inconvenience from his totally excluded and occluded intestine. Beneath the scar of the fistula, however, a soft mass could be felt, which was looked upon as an accumulation within the occluded loop.

The patient disappeared for another year, but at the end of this time he came back with a different history. He had suffered considerably, especially lately, with pain in the right half of the abdomen. The soft mass beneath the cicatrix had become converted into a large, semisolid protrusion, which seemed to be under considerable tension. Through an incision the occluded intestine, firmly adherent to the anterior abdominal wall, was opened and a large quantity of slightly tinged, yellowish material was evacuated, which had the consistency of molten wax and was absolutely odorless. Unfortunately this material was lost and cannot, therefore, be reported on. After a few weeks the fistula had again closed and remained closed for two years, when the patient again presented himself with a history of much suffering lately. He had lost in weight and was run down and, although

GASTRIC AND DUODENAL ULCER

still complains of some nervousness in diminished amount, especially from some excitement or irritation. No goitre can be felt. Exophthalmos has never been noticeable.

CASE II — *Exophthalmic goitre. Ligation of 3 arteries.* Female, native of Russia, thirty-four years old, married, four children. Was admitted to St Mark's Hospital, December 29, 1914, complaining of precordial pain, nervousness, insomnia, throbbing in neck, sweating, tremor and diarrhoea, with occasional attacks of vomiting. These symptoms began a year before, had grown steadily worse in spite of medical treatment. No serum therapy had been used. She stated that she had lost 60 pounds in weight. This patient presented many symptoms of Graves's disease and most of them in a very exaggerated form. This was true particularly of the nervousness, tachycardia, pulsation in the neck, and tremor.

On December 31, I ligated the two superior thyroids and the right inferior thyroid gland under 1 per cent novocaine. The patient has shown remarkable improvement in the past two weeks since the operation. The exophthalmos is still evident, but the nervousness, tachycardia, pulsation in the neck, tumor, and tremor have diminished very materially in this short time. I believe we may confidently expect a cure without further operation.

Dr Tilton added that his preference was for ligation of three arteries under local anæsthesia at one sitting and the employment for this purpose of a single transverse incision just as in performing thyroidectomy. He did not think that repeated ligations were practicable in hospital patients, as they will usually refuse a second operation and then a complete cure is not obtained. He did not believe that in most cases immediate or subsequent removal of the gland is necessary if the three arteries are tied. Separate incisions for the various arteries means more mutilation. In his experience the operation under local anæsthesia does not produce a serious reaction. The results that he had obtained from ligation of these arteries are materially better than those from ligation of one or both superior thyroids and the reaction is not materially greater.

GASTRIC AND DUODENAL ULCER

DR CHARLES H. PECK read a paper with the above title, for which see page 406.

the case is a suitable one, for irrigation and cleansing of the loop. After many months of such treatment, if the discharge from the fistula had entirely ceased, special conditions, as the existence of a huge prolapse in the speaker's case, might demand complete occlusion of the entire loop. In the light of Wiesinger's and the speaker's experience this operation would not entail any immediate risk after proper preparation of the excluded loop, but from the further course of both cases it followed that such patients should be kept under close observation or, preferably, that a small opening should later on be established, to guard against the sudden advent of serious complications, as in Wiesinger's case.

ARTERIAL LIGATION FOR EXOPHTHALMIC GOITRE

DR B F TILTON presented two patients, as follows

CASE I—*Exophthalmic goitre Ligation of three arteries*

Female, native of Hungary, married, thirty years of age. Was admitted to St Mark's Hospital July 11, 1914, complaining of weakness, occasional fainting attacks, palpitation of heart, throbbing of neck, severe sweating, and diarrhoea. Has had four children, youngest two and one-half years old. Patient dates her illness back to two years before, when she was much concerned over her father's serious illness. At that time she first noticed palpitation of heart and fainting attacks. She gradually gave up her housework. Eight months ago noticed a small swelling in front of neck, also tremor of hands. Six months ago all symptoms became intensified and she was treated by rest and tonics at home for three months. She was given several times the Beebe-Rogers serum. She then went to a hospital, where she was under observation for three weeks, and then operation was advised, as she was growing steadily worse. Before operation her pulse averaged 110 and her weight was 119 pounds, having lost in two years 45 pounds. On July 21 last the two superior thyroid arteries and the right inferior thyroid were tied under local anæsthesia with 1 per cent novocaine. There was considerable aggravation of all symptoms at first, the temperature rising to 102° and the pulse to 140. This reaction subsided promptly, and when she left the hospital three weeks later her pulse averaged between 90 and 100, her temperature was normal, and all symptoms showed beginning improvement. At the present time, six months after operation, she is vastly improved. Her weight is now 150 pounds, a gain of thirty pounds, her pulse is much slower, she has no throbbing in the neck, her appetite is good, no diarrhoea and no attacks of fainting. She



FIG 1 —Skull, showing fracture of condylar process of mandible (Cryer)



FIG 2 —Anterior view of skull shown in Fig 1 Horizontal displacement of condyle is seen on left side (Cryer)

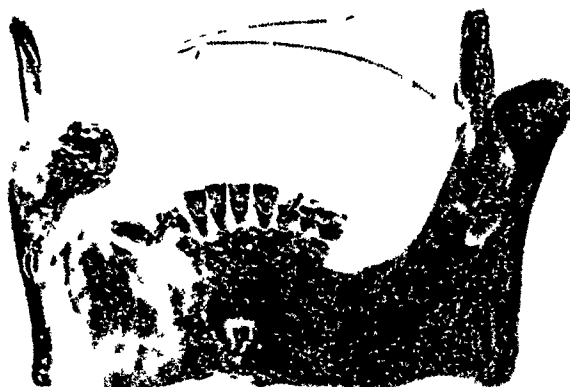


FIG 3 —Posterior view of dissected mandible showing typical deformity in fracture of left condylar process (Cryer)

TRANSACTIONS OF THE PHILADELPHIA ACADEMY OF SURGERY

Stated Meeting, December 7, 1914

The President, DR JOHN H GIBBON, in the Chair

SNAPPING SHOULDER

DR PENN G SKILLERN, JR, presented a man thirty-two years of age, a horse-back rider, who was first seen by him two months ago. Three months previous to that time he had fallen from a horse, but it was not until some time afterward that he complained of pain. During examination there was noticed a marked "snapping" of the shoulder—a definite shock or jar—upon elevating the arm to right angle and upon dropping it, skiagram negative. Dr Skillern said that he had been able to find but one similar case in literature. This is reported by Reich in 1913, at Frankfort. Upon operating Reich found an abnormal fissure between the short head of the biceps and the coracobrachialis muscles. He accounted for the snapping by assuming that in abduction of the arm one or other of the tendons caught upon the lesser tuberosity of the humerus. He furthermore thinks there is a small breach at birth between the two tendons and that the accident served to increase this gap. He, therefore, proposed the term "*Schnappschulter*," or snapping shoulder. The sound is best obtained by elevation of the arm.

FRACTURE OF CONDYLOID PROCESS OF MANDIBLE

DR ROBERT H IVY remarked that fracture of the condyloid process of the mandible, while not extremely rare, is only occasionally met with, and receives little consideration in works on surgery. Most of the textbooks give the briefest possible mention to the injury. Nearly all cases occur by indirect violence, from an upward blow on the anterior portion of the opposite side of the lower jaw. Roe¹ states that in 41 cases of fracture of the mandible examined by him 6 were through the condyloid process, an unusually high proportion of almost 15 per cent. Egger² has compiled statistics from various sources, giving the

¹ Roe, W J ANNALS OF SURGERY, August, 1903, p 221

² Egger, F Beitr für klinisch Chir, 1913, lxxvii, 294

FRACTURE OF CONDYLOID PROCESS OF MANDIBLE

frequency of this fracture as 4.5 per cent in 365 cases of single fracture of the mandible. In combination with other fractures of the lower jaw, fracture of the condyloid process occurs more frequently, the proportion of cases of multiple fracture with this injury being about 10 per cent, according to Egger's figures. But in counting the total fractures in these cases the percentage falls to about 5. Of 45 cases of fracture of the mandible recorded at the Philadelphia General Hospital from 1904 to 1908, together with at least 20 others personally examined by the writer within the last four years, only one—to be reported here—was of the condyloid process, a proportion of less than 2 per cent.

Roe, together with other writers, speaks of the frequency of this injury as a cause of ankylosis of the temporomandibular articulation. It would appear that no attempt has been made to classify the fractures as extracapsular and intracapsular. This distinction is of some importance, as the extracapsular fractures would naturally not be so liable to be followed by ankylosis as the intracapsular.

Egger states that fractures of the condyloid process generally occur without displacement, since the fragments are usually held in contact by periosteum and soft tissues. That displacement does frequently occur is borne out by two specimens from the collection of Dr. M. H. Cryer, each of which shows the typical deformity found in these cases (Figs. 1, 2, and 3). The condyle is seen to be drawn forward and inward by the external pterygoid muscle, bringing the upper fragment into a transverse and horizontal position, the portion of the process below the fracture being pulled upward and outward by the masseter, union having taken place with the fragments in this position without ankylosis. One of these specimens well illustrates also the deviation of the chin toward the injured side, first mentioned by Heath.³

The following case has recently been under the writer's care.

C. B., aged fifty-eight, male, white, teamster. Was kicked by a horse on the chin to the right of the median line. This resulted in an area of pain and tenderness at the place where the blow was received, and in a second area of pain and swelling on the left side of the lower jaw above the angle. The pain in the latter region was increased by attempts to open the mouth, which could only be done with difficulty. The patient applied for treatment at the Surgical Out-Patient Department of the University Hospital, on May 27, 1914, the day after receiving the injury. Examination showed some contusion of the soft parts in the

³ Heath, Christopher. *Injuries and Diseases of the Jaws*, 4th Ed., 1894.



FIG 4 —Lateral view showing fracture of left condylar process of mandible (Rontgenogram by Dr Pancoast)

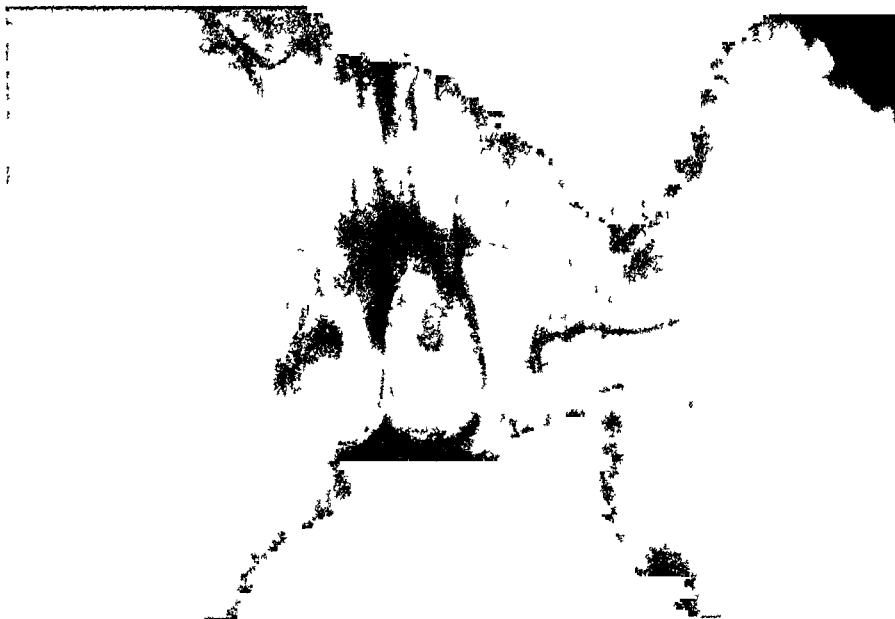


FIG 5 —Antero-posterior view showing fracture of left condylar process of mandible (Rontgenogram by Dr Pancoast)

FRACTURE OF CONDYLOID PROCESS OF MANDIBLE

Moderate movement should be permitted in all cases. Where there is extreme displacement of the upper fragment owing to excessive violence, or ankylosis seems unavoidable, excision of the condyle is probably advisable, followed by arthroplasty.

From a study of the skull in which the deformity is so well shown, Cryer suggests that by an anteroposterior X-ray view the horizontal position of the upper fragment should be readily seen, thus confirming the diagnosis of fracture of the condyloid process. Great care must be observed to have the patient's head in exactly the right position in taking the X-ray picture, or the condyle will be overshadowed by the dense bone at the base of the skull. This unfortunately happened in my case. The anteroposterior view taken in every suspected case of fracture of the condyloid process will frequently be of assistance in establishing the diagnosis. By making several plates at slightly different angles it should be possible to show the displaced condyle.

The differential diagnosis of fracture of the neck of the condyle from luxation without fracture should present no difficulty. In fracture there is usually crepitus, the jaws can be closed, while the chin is deflected toward the injured side. In dislocation, the jaws are held open, the chin is deflected away from the injured side, and the condyle makes a distinct prominence well in front of its normal position, though this may be masked by the amount of traumatic swelling present.

DR JOHN B. ROBERTS said that last summer he saw a lady who said she had recovered from a fracture on the left side of the face. She said she had slipped and struck that portion of her head against the corner of a table, and was told that there was a fracture of the lower jaw near the joint. She had looked upon it as a mere contusion. She then went, at the suggestion of her physician, to have an X-ray picture taken, which proved that a fracture of the condyle existed, evidently from direct injury. In the case reported by Dr. Ivy the man apparently received his by indirect injury, as the kick of the horse was received on the opposite side of the chin.

DR J. B. CARNETT said that he had recently seen a case of the fracture described by Dr. Ivy in a man of advanced years, who had fallen from a second floor window. He was unconscious—at the point of death for many weeks—and the fracture did not receive any treatment. Some months later he sought advice because of lack of alignment of his teeth. He had a depression at the area normally occupied by the head of the lower jaw and it was obvious he had sustained a fracture of some variety. Dr. H. K. Pancoast made a very excellent

canine region of the lower jaw on the right side. No crepitus or other signs of fracture were found in this region, and the X-ray was also negative. On the left side, there was a moderately extensive, puffy, tender swelling just below the zygoma immediately in front of the ear. Deep pressure elicited a point of greatest tenderness just below the normal position of the condyle of the mandible. The lower jaw was not fixed, but could be moved up and down with difficulty. Crepitus was felt at the point of greatest tenderness when this was done. On pressure over the region of the condyle when the jaw was opened, the normal forward movement of the condyle could not be felt. The lower incisor teeth were seen to be deviated toward the left side about half the width of a tooth. The X-ray (Figs 4 and 5), by both lateral and anteroposterior views, showed a fracture through the left condylar process of the mandible, somewhat low down, away from the head of the bone. In the lateral view, the upper fragment was apparently drawn forward, producing angulation at the site of fracture.

Treatment—In view of the very slight deformity present, it was thought advisable to treat the case, at first at least, by simple restriction of movement by means of a modified Barton bandage, not too tightly applied, with instructions to the patient to use the jaw with moderation. By this means it was hoped that ankylosis would be avoided, though it was not greatly feared, as according to the X-ray and clinical signs the fracture was apparently extra-capsular. As time went on, no other treatment was found necessary. The condition steadily improved, at the end of five weeks all bandaging was discontinued, the patient was free from pain, and could open the jaws to the normal extent. The very slight deviation of the chin toward the injured side remained, but caused no inconvenience. The condyle probably remained out of its normal position in the glenoid fossa, as a slight depression could be felt in this region instead of the usual prominence.

The case appears worthy of note, particularly on account of the absence of ankylosis, and the good result obtained with simple bandaging. It may be compared in many points with the anatomical specimens shown. The simple line of treatment carried out was suggested largely by the functionally good result evident in Dr Cryer's specimen. In the literature I find that Roy⁴ reports a case treated very similarly to this with equally good results. In no case is absolute fixation of the lower to the upper jaw by means of interdental splints advisable, owing to the proximity of the fracture to the joint with consequent danger of ankylosis.

⁴ Roy, M. L'Odontologie, 1913, xlix, 481

attack of cerebrospinal meningitis. He was confined to bed for nine weeks and most of the time was delirious. Since then more or less severe headaches have been rather frequent. During the summer of 1910 he passed bloody urine for the first time. The hæmaturia was not accompanied by any abdominal pain, and, in fact, the latter has never been present. The urine returned to normal after a course of medical treatment, only to become bloody again after a lapse of several months. He has never passed gravel and his general health has remained good despite the loss of considerable blood in the urine, which has always, during the past month, been dark red in color. There has been some sediment of late in the urine.

Physical examination showed an apparently healthy boy somewhat small for his age. A careful detailed examination showed nothing abnormal. Neither kidney was palpable, nor was there marked tenderness over either kidney area.

Examination of the urine showed specific gravity 1020, color light red, trace of albumen, no sugar, no casts, moderate number of urates, macroscopic and microscopic blood.

The X-ray report showed stones in both kidneys—one large stone in upper pole of right kidney and one large stone and two smaller ones in the left kidney. The large stone in the left kidney was in the pelvis, the other two in the other pole. It was decided to remove the stones at different times, so that, on February 10, 1911, the right kidney was attacked under ether anæsthesia through the usual oblique incision. On exposing the kidney the stone was readily felt and removed, through an incision into the cortex. Rather free bleeding was encountered, but was easily controlled by catgut sutures. The stone was hard and about the size of an almond. The wound was closed with gauze drainage.

Following this operation the boy's recovery was uneventful, after rallying from rather marked operative shock. The gauze was removed at the end of forty-eight hours and the wound stopped draining urine one week after operation. The child was discharged three weeks after operation in satisfactory condition, the wound having entirely healed. On several occasions after the operation there was blood in the urine, although it had disappeared at the time of leaving the hospital.

On November 12, 1911, he was readmitted, his health having been good in the meanwhile. His urine had not contained blood in the interim. A second X-ray examination showed, as before, one large and two smaller stones in the left kidney. On November 16 the left kidney

X-ray picture of his lesion The skiagraph shows a not uncommon type of deformity in which a fracture occurs through the neck, the head rolls inward, and the bone reunites in that position

THE PAINFUL SUBCUTANEOUS TUBERCLE

DR H R OWEN (by invitation) read a paper with the above title, for which see page 451

DR P G SKILLERN, JR said that he attended a case at the University Hospital Dispensary during the summer which was very much akin to the one described by Dr Owen The patient was a male, aged twenty-nine years, who for two years had had a sensitive spot at the upper outer portion of the left leg, and he had pain in the leg at night He had had a skiagram taken and was said to have an osteoperiostitis An X-ray taken under Dr Skillern's direction was negative On the upper outer portion of the left leg was a minute mole the size of a millet seed Touched by the tip of an ordinary probe this little tumor was the seat of excruciating pain The tumor was removed under novocaine suprarenin infiltration A clinical diagnosis was made of neurofibroma Histologically, the condition was a small encapsulated growth, a hæmangioma, beneath the skin Last summer he saw a case with an exquisitely tender subcutaneous tubercle over the internal condyle of the right femur, which might have been diagnosed neurofibroma, but which cleared up under antigout treatment The diagnosis of these subcutaneous gouty nodules must always be borne in mind in surgical cases

DR OWEN, in closing, said that the case which prompted him to write the paper was that of a young lady, twenty-one years of age, who had a small tumor over the patella for a number of months It had been treated for some time by ointments Finally the knee became so painful that a splint was applied On one occasion the tumor had been diagnosed a ganglion and had been struck by a book with the hopes of rupturing it, whereupon the young lady fainted The leg was thrown into a clonic convulsion by this blow When she came under my observation she was walking with a stiff leg She was so apprehensive of pain she would not bend the knee Since the removal of the tumor she has had no further trouble

NEPHROLITHIASIS IN CHILDHOOD

DR J S RODMAN presented a boy of twelve years upon whom he had operated at different times for bilateral kidney stone The boy has always been undersized but otherwise, except for whooping-cough, has been healthy, until four years ago, at which time he had a severe

town of Weida, near Jena. As to the actual etiology, much diversity of opinion is found. Ebstein believes that certain salts excreted from the blood and retained by the kidneys cause damage to the renal cells, thus forming the necessary organic material for the formation of stones. Joseph, in a report of 42 cases in infants with necropsy, found an albuminous material filling the tubules, and believes that this substance is the foundation of stone. He attributes its formation to altered metabolism. Klemperer and Biugsch speak of a renal stone diathesis which is brought about by a change in the metabolism, probably an excess of stone-forming salts in the blood stream. This diathesis expresses itself through diseases of the stomach and central nervous system. Rosenbach believes that the damage to the renal cells is not primary, as Ebstein claims, but rather secondary, due to a blocking of the urinary stream. In support of this theory Muschka states that blocking of the urinary stream produces swelling of the tubule walls and thus causes stone deposition. Kubitz believes that stones are composed chiefly of uric acid and its salts. Ebert, however, considers that uric acid infarcts are so common in infancy as to be almost physiologic. He considers that endemic conditions play an important rôle in the formation of sediments in the kidney parenchyma and pelvis. A gouty heredity is frequently found. For instance, Gibbons reports six cases of kidney stone in children, all of whom had had gouty parentage. Calcium contents of the water and gastro-intestinal disturbances may also play a part.

The pathology of renal calculus depends entirely upon whether the stones are primary or secondary. By a primary stone we mean one which forms independent of infection and is usually round or oval, smooth, without processes into the calyces, hard, and on section their structure is more uniform and artistic. The chief point of difference is that they have a lower percentage of calcium. Such a stone causes little damage to the kidney substance. The pathological changes that are found are due to congestion, and consist in thickening of the capsule, exudation into the glomeruli, cellular infiltrations, and cell degenerations. On the contrary, secondary stones, being always the product of infection, are almost invariably accompanied by grave renal destruction. According to Ebert, the most common kidney stones are composed of sodium urate. In Mousseaux's series there were, of 77 cases, 55 urate stones, 12 mixed urate and oxalate, 1 pure oxalate, and 9 phosphatic. He states that cystin and xanthin stones are almost never found in children. In the series collected by Rafin, where the chemical composition was mentioned, there were . uric acid 5, oxalic

was exposed and the larger stone in the pelvis immediately felt. The kidney cortex was incised and a smaller calculus in the lower pole, about the size of a large pea, and a soft stone resembling a blood clot felt and removed. The larger stone in the pelvis was also removed and was about the size of a small pigeon egg. The boy lost somewhat more blood during this operation than the first, but again the bleeding stopped upon suturing the kidney, wound closed, as before, with gauze drainage. His convalescence from this operation was exceedingly stormy. Shock was profound, and for forty-eight hours suppression of urine made us fear that he would die. Cupping, external heat, salt solution and hot packs finally started elimination, but for one week his condition remained desperate. After this convalescence became established. The gauze was removed at the end of forty-eight hours, as before. He was discharged December 23, 1911, five weeks after operation in excellent condition. The wound had healed, having ceased draining urine ten days after operation. The urine report at the time of his second discharge from the hospital showed pale amber, flocculent sediment, specific gravity 1018, reaction acid, small ring of albumen, no sugar, no casts, few leucocytes, few pus cells, few epithelial cells, and a moderate number of urates. His health has been excellent since the last operation, he has grown rapidly, and, strangely enough, does not now suffer from headaches. At no time since the second operation has there been blood in the urine.

Dr Rodman remarked that the subject of kidney stones in children had received but scant attention in comparison to the wealth of literature on the same subject in adults. Several important articles have appeared, however, during the past ten years, which deal largely with the etiology and pathology of stones. Despite the fact that most of the text-books of surgery dismiss the subject with the mere statement that renal calculus in children is common, the more recent literature would seem to indicate just the opposite. Nephrolithiasis in children is rare, but bladder-stones, with which we are not concerned in this report, are common. Age, sex, and race have some influence.

Thus, in Rafin's series of 39 cases, 2 of his own and 37 collected from literature, 5 were from one to five years, 18 from five to ten years, and 12 from ten to fifteen years. There were 24 boys and 11 girls in this series. Again, in the Mousseaux series of 77 cases there were 51 boys and 26 girls, while in Neupaner's series of 100 cases only 5 were girls.

It would seem that stone is more common in Hungary, Upper Silesia, England, Turkey, the country of Altenberg, Germany, and the

APPENDICULAR OBLITERATION

DR. DAMON B. PFEIFFER presented a paper with the above title, for which see page 438

DR JOHN B DEEVER said that he believed and could prove by bacteriological research, that the appendix is responsible for the majority of cases of cholecystitis. According to reports from the Laboratory of the German Hospital 25 per cent of the cases of gall-bladder operations showed the colon bacillus

The typhoid bacillus is next to the colon bacillus in causing infection of the gall-bladder, but that the colon bacillus predominates there is no question

DR JOHN H GIBBON urged on behalf of the original title of this paper, "Obliterative Appendicitis," that it was the better title, because the paper shows distinctly that the obliteration of the appendix was probably of inflammatory origin. It is a term also that has been used right along and is descriptive of obliterative results of inflammatory change.

DR PFEIFFER, in closing, said, in explanation of the title "Appendicular Obliteration," that it was simply to call attention to the fact that the ending "itis" in "obliterative appendicitis" is misleading, unless it is thoroughly understood that the inflammation is past. One sees obliterated appendices of recent date in which there is still an active inflammatory process, but, in the vast majority of obliterated appendices, there is no more inflammation. The object is to call attention to the fact that there are no inflammatory processes present

TYPHOID SPINE

DR J. B. CARNETT presented a paper with the above title, for which see page 456

acid or urate 4, phosphate of lime 4, carbonate of lime and phosphates 4, urates and phosphates 2, urates and oxalates 2

In the symptomatology of kidney stones as occurring in children one is struck by the infrequency with which renal colic is mentioned. In fact, pain does not seem to be a prominent factor. It was entirely absent in my case, and writers on the subject have mentioned its infrequency. Hæmaturia is an important symptom, as is sediment in the urine.

Certainly the diagnosis rests almost entirely upon the X-ray. Here it must be remembered that not all varieties of stone are equally impermeable to the rays. The softer uric acid stones do not, for instance, throw as definite shadows as the harder varieties. The treatment, of course, is surgical, once the stone is formed and symptomatic. Renewed importance must be attached, however, to subsequent medical treatment, as surgery cannot cure the stone-forming diathesis. There is no doubt that the kidney possesses definite solvent properties, as is shown in the experimental work of Rosenbach on oxamide stones. These substances were placed in the kidneys of dogs, and when the organs were subsequently removed marked absorption had taken place. What is true of unilateral kidney stones is also true, in general, of bilateral calculus. In a series of 76 cases, 38 were bilateral, according to Legen. Kubitz collected several series of kidney stones, reported by different authors, occurring at all ages, and found that as an average 18.7 per cent were bilateral. An ascending infection of the sound kidney following cystitis of course predisposes to secondary stone formation. In this way unilateral stone may become bilateral, since calculus is so frequently followed by cystitis. Other case reports, as those of Nash, Jaffrey, and Parkinson, remark upon the relative infrequency of kidney stones in children. Out of 96 operations, Morris states that none was under ten years. R. C. Dunn states that in 283 cases there was only one under ten years.

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BLASTOMYCOSIS

By F E McKENTY, M.D., F.R.C.S. (Eng.)

AND

D. MORGAN, M.D.

OF MONTREAL

A CASE of blastomycosis occurring in an unusual situation recently came under observation at the Royal Victoria Hospital, Montreal. It had been previously diagnosed as tuberculosis, and unsuccessfully treated as such, and this fact, as well as its unique situation, stimulated us to report it along with several other cases found in the hospital records, and to briefly review the literature.

There are two forms of this disease—the cutaneous and the systemic.

As a rule, the former begins as a papule or papulo-pustule which slowly enlarges. Most cases do not come under observation till they have attained a considerable size, *e g*, that of a twenty-five-cent piece or even larger, have ulcerated, and are discharging a serous or sero-purulent secretion. The following are the chief characteristics of this form.

A patch of varying size projecting slightly above the surrounding skin and covered by irregular papilliform elevations, giving it somewhat the appearance of a cauliflower. This appearance is due to the presence of more or less bulky crusts which cover the surface of the lesion. On removal of these crusts the papules proper are seen, small, firm and comparatively dry in the younger lesions; large, lobulated and covered with a seropurulent secretion in the older or untreated lesions. The edges (see Case I, Fig 1) are smooth, sloping, of a dull red color and sharply defined from the surrounding skin, on close observation they show numerous miliary abscesses. It is from these abscesses that the causative organism is best obtained in pure culture. A drop of pus when treated with 20 per cent. KOH and examined under high power reveals the organism as a double-contoured, vacuolated, yeast-like body which frequently shows budding forms. This latter condition is of

BOOK REVIEW

ABDOMINAL SURGERY Clinical Lectures for Students and Physicians
By THORKILD ROVSING, Professor of Clinical Surgery at the University of Copenhagen Edited by PAUL MONROE PILCHER, M D , A M
J B Lippincott Company, Philadelphia and London

The translator of this volume of clinical lectures has rendered a distinct service to American surgeons in presenting in English such original lectures as these of Professor Rovsing. The lectures are upon diseases of the œsophagus, stomach and liver which are amenable to surgical treatment. An account is given of the use of the gastroscope devised by Professor Rovsing, for examination of the duodenum and stomach through direct inspection. It is impossible to present a review of this book without going into more detail than is practicable. Professor Rovsing evidently has a large surgical clinic and in these pages he presents his views of the pathology of the diseases considered and describes his own personal treatment for such conditions. The book, therefore, is eminently practical and gives to the reader a good conception of this surgeon's work. The translation is a literal one, so that none of the meaning of the author has been obscured. It is wise for all surgeons to be familiar with the work of men in other clinics, both abroad and in this country. This book will serve a useful purpose in acquainting American surgeons with the work of Professor Rovsing.

CHARLES L. SCUDDER

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in the study of actinomycosis at the Royal Victoria Hospital it was found that an abrasion was also necessary before infection could occur (*Jour of Am Med Sc*, June, 1913).

Clinically, the disease must not be confused with tuberculosis verrucosa. The following are the more important points of differentiation. the characteristic border and abscesses of blastomycosis of the skin, the results of histologic and bacteriologic examination, and the fact that the morbid condition improves under the influence of potassium iodide. Of lesser importance is the more frequent occurrence on the face and the more rapid development than lesions generally recognized as tuberculous. The constitutional symptoms of tuberculosis are also absent. Lupus vulgaris is distinguished by its characteristic nodules. Only the hyperplastic form of the disease could be confused with cutaneous blastomycosis. The differential features are practically those considered under tuberculosis verrucosa. In addition, tuberculosis verrucosa is a disease of early life while blastomycosis most frequently occurs after forty.

The disease may be confounded with syphilis, but other manifestations of this latter condition will usually be present. From carcinoma the disease can be differentiated by the soft base, by the multiplicity of the lesions, by the absence of glandular enlargement, and by the improvement and spontaneous healing shown under the influence of potassium iodide.

The surgical treatment consists in removal *en masse* where possible and this is probably the most effective method of cure. If this is impossible curetting may be tried, but it is not a certain preventative of the return of the malady. Medicinally, potassium iodide appears to be almost a specific and should be given in large doses. It does not appear to act directly on the organism but stimulates the tissues to ward off the disease. A combined surgical and medical treatment is frequently employed. X-rays have been recommended, but in Case IV of our series, which at first was diagnosed as lupus and treated as such by X-rays, the condition seemed only to be aggravated. The prognosis is generally favorable unless complicated by some intercurrent infection.

Following are detailed reports of four of the six cases occurring in the hospital records. Case III is of particular interest, as it shows the liability of the disease to become general.

CASE I—A V, age forty-eight, Italian laborer. One year ago patient first noticed a hard swelling just posterior to anus, about the size of a hazel-nut. This was opened with a pin and a small amount of blood-stained fluid escaped. Shortly after this hard

great diagnostic value, as it eliminates the possibility of confusing degenerated cells, fat globules, air bubbles, etc., with the organism proper. Media inoculated with this pus will show in the majority of instances a growth in from two to sixteen days, the appearance of which will vary greatly according to the medium used, the temperature and the amount of moisture present.

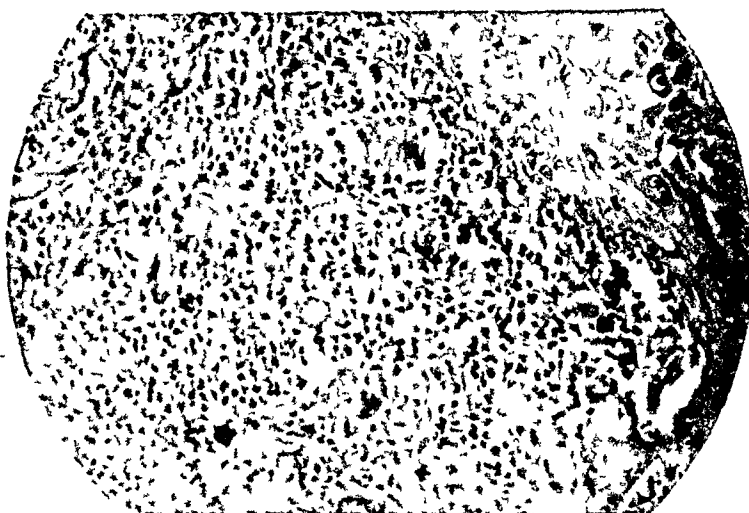
It has been suggested that these variations in appearance are due to the presence of more than one variety of blastomycetes. Viewed under the microscope, cultures show a mycelium with bud-like projections and also budding forms similar to those seen in pus. The mycelium formation does not occur in the tissues. Histologically, the most marked changes occur in the rete, which is the seat of an extensive hyperplasia, sending down irregular prolongations into the corium. The hyperplasia has been mistaken for epithelioma. These prolongations contain the milary abscesses which are so characteristic of this disease.

The abscesses vary in size and are found in all parts, both superficial and deep, of the hyperplastic epithelium. They contain leucocytes, epithelial detritus, giant-cells of the Langhan's type and, most important of all, the organism peculiar to the disease is present in varying numbers and is easily overlooked. Too much emphasis cannot be laid on the presence of giant-cells. Although they are of the type usually seen in tuberculosis and have misled many into diagnosing the condition as such, they are in all probability "foreign-body" giant-cell formations, and closer examination will reveal the presence of the specific organism in their vicinity (Fig 3). The histological picture may be summarized as a hyperplasia of the rete, the formation of milary abscesses containing the organism and the presence of giant-cells. The most important fact in the etiology is that the disease is undoubtedly due to infection of the blastomycetes. Why certain yeasts should be pathogenic while others are not is still an unsolved problem. No predisposing causes have been recognized, but the following conditions have been noted in the cases reported, viz unfavorable hygienic surroundings, some debilitating systemic conditions (*e g*, diabetes, as in Case III), males are more often infected than females, probably owing to their more frequent exposure to infection, any age, but apparently more frequently met with between the fortieth and sixtieth years, and trauma.

We believe this latter factor to be of considerable importance and that the organism will not grow on the intact skin, some abrasion being necessary for infection to occur. In corroboration of this we note the history of trauma in all the cases reported in the hospital, and further,



FIG 1 — Case I Shows ulceration posterior to anal orifice. Note raised edges and papillary appearance



Double
contoured —
organism

FIG 2 — Showing organisms in granulation tissue

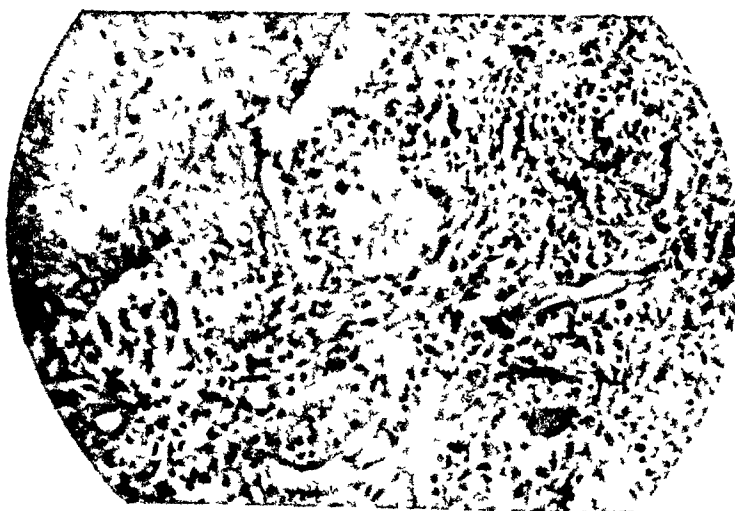


FIG 3 — Organisms near giant cell. No proliferation of epithelium and atypical peritubercular formation

mass ulcerated, the ulcer gradually increasing in size. This condition was diagnosed as a tuberculous ulcer and curetted. The glands in the inguinal region became involved and broke down, discharging pus. Examination showed an ulcerated area just posterior to anus (see Fig 1), extending backward in anal cleft, $1\frac{1}{2}$ inches by $1\frac{1}{2}$ inches. The surface of the ulcer was bright red in color, with granular appearance. The edge was raised and seemed to be composed of numerous small papillomas (Fig 1).

Treatment—Curetting of ulcer, plus potassium iodide, grs 30, t i d

Result—Improving

Pathological Report—Pus from inguinal region showed typical double-contoured organisms. Sections of tissue revealed marked epithelial hyperplasia, numerous small collections of polymorphonuclear leucocytes and numerous giant-cells of Langhan's type (Fig 2), while here and there, particularly near the giant-cells or in the abscesses, the organism was seen (Fig 3).

CASE II—J O, age sixty-three, farmer. Seven weeks previous to admission to hospital, while passing through woods, received a small scratch over malar eminence by a branch. A scab formed over the abrasion under which a small quantity of pus escaped. On entrance to the hospital the ulcer was the size of a twenty-five cent piece and covered with a thick scab, had a rather punched out appearance, and the skin surrounding was reddened and thickened. Submaxillary glands enlarged.

Treatment—Excision of ulcer, plus potassium iodide, grs 30, t i d

Result—Cured

Pathological Report of Tissue—Sections showed marked hyperplasia of the epithelium, owing to downgrowth of lower layers. In places atypical pearl formation was noted. Small abscesses were numerous in the epithelial downgrowths, while throughout the section giant-cells of the Langhan's type were seen. Later definite and typical blastomycetes found.

CASE III—Italian, age forty-three, laborer. Admitted April 3, 1910. Died June 14, 1910.

Complaints—Sore right eye

Trouble began about middle of September, 1909, when he first noticed a small pimple about the size of a split pea on the outer side of the external canthus of the right eye. It was slightly tender and gradually increased in size till early in December, 1909, when it broke down and began discharging a small quantity of blood-stained, thin material. This continued till the present. There has been a certain amount of surrounding œdema since January 1, 1910. He does not complain of pain but of tenderness. Has had

occasional headaches. Has always been a healthy man and denies venereal trouble. No history of injury could be obtained. Family history negative.

Present Condition—Fairly well-developed and well-nourished man. Pale, not complaining of pain but of tenderness around sore—and of headaches. Over the right temporal region extending from temporal ridge downward, including outer third of right eye over to the malar prominence, is a diffuse swelling, very slightly discolored and tender. Point of maximum tenderness is just over temporal region, $1\frac{1}{2}$ inches behind the outer canthus, and on a somewhat higher level. There is a small discharging sinus close to the temporal side of the outer canthus, the edges are red, slightly swollen, and fresh masses of granulation tissue discharging a small quantity of a sero-mucopurulent material are seen. An ordinary-sized probe could be passed upward and backward a distance of $1\frac{3}{4}$ inches. Respiratory, circulatory, and genito-urinary systems normal. Urine: amber, clear, acid, 1022, no albumen, no sugar, no casts.

Treatment—Potassium iodide, grs 30; i d.

Diary—April 11, incision made over right temporal region down to bone. Peculiar condition found in bone. Small piece kept for examination. Cut surface of bone did not bleed much. Sinus was curetted and discolored tissue removed, wound packed with iodoform gauze. April 16, complained of bad headaches, very restless, same on April 17. April 20, dressed, no discharge, wound granulating up. April 27, slight chill, no rise in temperature. May 15, smears taken of pus in eye (?) showed many typical blastomycetes (Drs Keenan and McKenty). June 1, sinking fast, taking no nourishment, dull, sleeping most of the time. Died June 14.

Diagnosis—Blastomycosis infection.

Post-mortem Examination Four and a Half Hours After Death—Mycosis of widespread type, caries of frontal bone with suppuration, suppuration of ethmoidal sinus, sphenoidal sinus, and superior nasal meatus, caries of right temporal bone, basal suppurative meningitis, internal hydrocephalus; retropharyngeal abscess, disseminated suppurative foci in lungs, old scars on extremities; pleural adhesions, chronic pericarditis, atheroma of aorta (slight), fatty degeneration of liver, nodules in spleen, retention cysts in kidney, congestion of small and large intestine, purpuric hemorrhages of skin.

NOTES—The case has been previously classed among the blastomycoses and is of very remarkable nature, first, owing to the rarity of generalization of disease in infections of this kind, second, owing to the nature of the bone lesion. The steadily pro-

THE OPERATIVE TREATMENT OF ARTERIAL THROMBOSIS AND EMBOLISM*

BY FRANCIS T STEWART, M D

OF PHILADELPHIA

PROFESSOR OF CLINICAL SURGERY IN JEFFERSON MEDICAL COLLEGE

OUR interest in the subject which forms the title of this paper has been aroused principally by the study of three cases in which efforts have been made to relieve arterial obstruction by surgical means. Two of these cases, in which the femoral artery was concerned, were reported in full to the Philadelphia Academy of Surgery in May, 1907, and are here reproduced in abstract. The third case, one of embolism of the abdominal aorta, is now published for the first time.

The operative methods that have been proposed for dealing with thrombosis and embolism of the arteries are (1) ligation, (2) arterio-venous anastomosis, (3) arteriotomy, (4) arterial resection, (5) arterial catheterization.

1 *Ligation* of the affected artery, distal to the point of obstruction, has been suggested in order to prevent the detachment of emboli. Whether this suggestion should be adopted or not depends, to a large extent, upon the frequency with which emboli are liberated from the point of obstruction, upon the damage that such emboli may produce after they are set free, and upon the possibility of recognizing an intra-arterial clot when it is most likely to launch particles into the blood stream.

The constant attrition of a strong current of blood on a growing mural thrombus is surely conducive to fragmentation of the more recently formed layers of that thrombus, and it is our belief that minute particles of blood clot, which are, however, too small to cause mischief unless laden with bacteria, are always washed from a non-occluding thrombus and from an occluding thrombus that has reached the parent stem of the vessel in which it lies. The process is a microscopic, symptomless embolism, and it accompanies the healing of all wounds involving blood-vessels, hence may be regarded as a normal phenomenon of repair.

In contradistinction to this physiologic embolism, pathologic embolism from a developing arterial thrombus or an arrested embolus

* Annual oration, read before the Philadelphia Academy of Surgery, January 3, 1915.

gressive carious change which took place and the extension of disease by actual continuity from the forehead through the orbital plate to the various cells at the root of the nose, with secondary infection of the meninges on the one hand and partial involvement of the orbit on the other, and the spread shown finally into the retropharyngeal tissue, are all worthy of great note and full of interest. The organism at work was a spherical body with well-defined capsule and chromatic granules in its interior. It multiplied by fission, one individual producing two others or more. A culture which was at the time successful showed a growth which was definitely mycelial, so that it shows an alternation of generation accounting for its encysted form in this case. It is probable that the lung condition was due to aspiration, since there were no secondary deposits elsewhere. The nodules in the spleen are apparently of a different nature. (O. C. Gruner, Path. Dept., R. V. H.)

CASE IV—Mrs. D., age thirty-two, farmer's wife

Complaints—Growth on nose

History of Present Illness—Two months previous to entrance to hospital a small pimple appeared on tip of nose which gradually increased in size, around the edge other similar ones appeared and these gradually coalesced until the whole lower half of the nose was involved. The ulcerated area has a peculiar warty appearance. The edges fade gradually into the surrounding skin in places, while in other areas the edge is heaped up and of dark brownish color. On the surface of the ulcer numerous papilliform growths were noted, in the centre of which small drops of pus can be extruded. In the older parts of the growth these papilliform projections become more closely applied and were covered with thick dark scabs which, on removal, revealed a small ulcerated surface. These crusts are often very adherent. The glands of the neck are not involved. Personal history negative.

Family History—Several relatives died of tuberculosis.

Treatment—At first the condition was looked upon as lupus, and treated with X-rays, which seemed to increase the rapidity of the growth, as after the beginning of treatment the disease spread very rapidly. Later examination of pus revealed the organism. Afterwards this patient was put on iodides and she immediately showed signs of improvement.

operation which has enthusiastic advocates and strong opponents. Probably most surgeons are in a state of indecision as to the merits of this procedure. According to some experimenters, reversal of the circulation in the veins is impossible, owing to the resistance offered by the valves. Other experimenters, notably Carrell, have succeeded by arteriovenous anastomosis in filling the veins with red blood. None has demonstrated, however, that this red blood passes through the capillaries before returning to the heart.

It is probable that with time the valves might be forced to yield to the constant bombardment of the blood diverted from an artery into a vein, and that, aside from actual tearing or stretching of the valves, they might easily be rendered incompetent by the dilatation of the vein in obedience to the increased intravenous pressure. In either event, however, the time would have to be brief if the part threatened with gangrene is to survive, and the constant hurling of the blood against the valves with the consequent eddies in the stream would surely predispose to thrombosis, especially if the valves were lacerated, instead of simply bent back or separated. In addition to these theoretic considerations we have undisputed clinical evidence that in certain cases of varix and arteriovenous aneurism the blood flows centrifugally in the vein.

Reversal of the circulation in the capillaries and arteries, however, would seem to be possible only in an organ with a terminal circulation. If the veins, as is the case in the extremities, have numerous anastomotic branches the arterial blood diverted to the principal vein will always seek these branches, and return to the heart in collateral venous channels, in which the pressure is feeble, rather than overcome the greater resistance of the capillaries and thus reach the arteries. Here again, *et c.*, in the arteries, the presence of anastomotic branches, if functioning, would offer an insurmountable obstacle to a centripetal flow of blood from the capillaries, since the red blood in these anastomotic branches would quickly distend the main artery, below the site of the artificial arteriovenous junction, with greater force than that of the dark blood accumulating from the capillaries. This dark blood, even if regurgitated into arterioles without anastomotic branches, would, in most instances, only hasten their obliteration by thrombosis, since, in addition to the coagulative tendency of used blood, the arteries would be, in most instances, badly diseased and, owing to the fall of blood-pressure consequent upon their assumption of the function of veins, much reduced in calibre.

It is probable that in most of the cases of arteriovenous anastomosis

is rare, at least so far as can be estimated from a clinical study of the subject. One of the reasons for this rarity is that the separated clot must be of a proper size to cause symptoms. If it is of microscopic dimensions and aseptic it is incompetent to work harm. If it is of great size, almost as large as the original clot, it becomes impacted immediately distal to the original clot and not in one of the branches of the affected vessel. Despite the greater blood-pressure in the arteries, which fact might lead to the inference that an intra-arterial clot would be more liable to suffer disintegration and dispersion than a clot in a vein, arterial thrombosis is decidedly less apt to result in harmful embolism than venous thrombosis. Owing to the composition of the arterial blood, a thrombus in an artery forms more slowly than one in a vein, hence is firmer in consistency. The walls of an artery are thicker than those of a vein, consequently a thrombus in an artery is less liable to be displaced by pressure from without. The arteries diminish in size in the direction of the blood current, as a result an occluding thrombus in an artery cannot be driven farther, whereas in a vein, which increases in calibre in the direction of the blood current, a thrombus may be washed *en masse* from its moorings.

Even though observation leads to the conclusion that emboli of proper size to cause trouble seldom arise from an intra-arterial clot, if the damage to the tissues deprived of blood by such emboli were great, ligation might still be urged to avert that damage. A small clot floating from a partly occluded artery is not likely to inflict more harm than total occlusion of that artery by ligation, whether the artery be the aorta, the brachial, the femoral, or the carotid. A small clot freeing itself from a mural thrombus which later becomes occlusive might, however, seriously interfere with the development of a collateral circulation, and the same result might be caused by a small clot thrown from an occlusive thrombus.

Even with the possibilities just mentioned in mind, however, ligation cannot, as a rule, be recommended, because the greatest danger of detachment of emboli is when the thrombus is forming, in other words, when the diagnosis of thrombosis cannot be made. When the diagnosis is certain, the thrombus is occlusive, and the danger of embolism is probably passed. Small particles can no longer be driven from the clot, and it cannot be displaced *en bloc*, because the vessel beyond is smaller than the thrombus.

2 *Arteriovenous anastomosis*, above the point of arterial obstruction, in order to induce the arterial blood to flow through the veins towards the periphery, and so reach the undernourished tissues, is an

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in so far as reversing the circulation is concerned, but that improvement in the symptoms, at least, temporary, occurs in a few instances there can be no doubt

In view of this fact, and despite the theoretic objections to arteriovenous anastomosis, it cannot be condemned utterly. It may be that circumstances occasionally will arise under which the conscientious surgeon, forced to a decision between this operation and eventual amputation, will be willing, after laying the experimental nature of the proceeding before the patient, to perform an arteriovenous anastomosis, in the hope that he may do no harm and possibly may effect some good. It may be, too, that future experimental or clinical evidence will force us to alter our views of this operation.

If arteriovenous anastomosis is decided upon, the method to be employed should receive serious consideration. The method which is physiologically ideal, so far as the effort to obtain complete reversal of the circulation in the vein and the artery is concerned, consists in severing the artery and the vein and then uniting, end-to-end, the central segment of the artery to the distal segment of the vein, and the distal segment of the artery to the central segment of the vein. There are, aside from its technical difficulties, three important objections that may be lodged against this procedure. The vessels are crossed at the point of suture and exert pressure on each other, thus retarding the flow of blood through the anastomoses and predisposing to thrombosis. If the artery below the point of anastomosis is patent and its connections with collateral arteries undisturbed, part of the blood from these collateral branches will stream up the artery and into the vein, and thus be diverted from the capillaries where it is so greatly needed. If thrombosis occurs at the point where the peripheral arterial segment is joined to the proximal venous segment, a portion or the whole of the thrombus may be driven or drawn into the vein and be carried to the pulmonary artery or one of its branches. These objections may be overcome by sacrificing the physiologic ideal and tying the peripheral end of the artery and the proximal end of the vein, trusting that the blood which is driven into the distal segment of the vein may find its way back to the heart through collateral venous channels. The same result, *i e*, shunting the arterial blood into the vein and forcing the blood to seek channels other than those of the main artery and vein in its journey back to the heart, may be obtained by performing lateral anastomosis and then tying the vein proximal and the artery distal to the anastomosis, by implantation of the upper end of the artery into the side of the vein, with ligation of the vein above the anastomosis and

for threatened gangrene in which the results are reported as favorable the operation was a failure, *i e*, that thrombosis occluded the vein and the artery at the site of anastomosis, and that the amelioration noted in the symptoms was due, not to increased blood supply, but to interference with the venous drainage. This probability is supported clinically by those cases of Raynaud's disease temporarily benefited by the application of elastic constriction to the base of the limb, and also by von Oppel's experience in securing, by means of ligation of the popliteal vein, a return of warmth, color and sensation in a leg menaced by gangrene. If the arteriovenous fistula remains patent the chances are, unless our theories are entirely wrong, that the blood shunted from the artery to the veins does no more than hinder the return of blood in those veins, thus contributing to passive hyperæmia. Another explanation, applicable to a few of the "successes" in preventing gangrene, especially in the upper extremities, is that, owing to an adequate collateral circulation, gangrene would not have occurred without operation.

If the collateral circulation is adequate, and the anastomosis is made immediately above the point of arterial obstruction, the only harm that could be done, aside from the evil possibilities attending all operations, is obliteration of the vein by thrombosis, and perhaps this might prove, as pointed out above, beneficial rather than injurious. If, however, the collateral arterial circulation is not competent to irrigate the limb, and there is still some blood passing through the artery, or if functioning arterial branches exist between the point of obstruction and the anastomoses, failure of the operation, *i e*, thrombosis, would increase the danger of gangrene.

Since 1902, when San Martín reported the first case, arteriovenous anastomosis for restoring the circulation has been done about 70 times. Once between the carotid and the internal jugular, twice between the brachial vessels, four times between the popliteal vessels, once between the anterior tibial artery and the internal saphenous vein, and the rest between the femoral vessels. The indications were hemiplegia, probably embolic, in one case, embolism in two cases, traumatic destruction of the vessels (excision for sarcoma and aneurism, gunshot wound, rupture of the vessels from lightning stroke, crushing accident) in five cases, and to prevent or to limit arteriosclerotic gangrene (including Raynaud's disease) in the remaining cases. In about 20 per cent of these cases the results are said to have been satisfactory. Most of these apparent "successes" are seriously questioned by unprejudiced observers, and it is highly probable that the operation is never successful

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was opened, the embolus extracted, and the artery sutured. Pulsation immediately reappeared in the femoral below and in the popliteal, but not in the tibial vessels, and this pulsation continued for eight days. The gangrene did not extend after operation. Forty-two days later the leg was amputated below the tubercle of the tibia. About 15 ligatures were necessary and the bone bled freely on section. The popliteal artery contained a small clot, and a probe passed up into the artery for several inches caused a slight flow of blood.

In 1907 three additional arteriotomies for embolism were reported. DOBERAUER opened the right axillary artery and removed an embolus 52 hours after its impaction. Thrombosis occurred within a few hours and the artery was again opened and the clot extracted. The thrombus reformed and two days later an anastomosis was made between the artery and the vein, whereupon the gangrene ceased to spread.

HANDLEY attempted to aspirate and to wash an embolus from the left common iliac artery, 12 hours after its impaction, by passing a catheter through the deep femoral, the common femoral, and the external iliac. He succeeded in inducing a pulsating flow of red blood, but death occurred 24 hours later.

MOYNIHAN removed an embolus that had lodged in the popliteal artery, the patient died four days later. The condition of the leg after the operation was not mentioned.

Arteriotomy for embolism of the pulmonary artery, which was suggested by Trendelenburg in November, 1907, and which has thus far always been followed by death, we have excluded from our discussion, as the pulmonary artery belongs physiologically to the venous side of the circulatory apparatus.

In 1909 MURPHY incised the femoral artery four days after the onset of acute ischæmia in the left lower limb, and dislodged an embolus from the common iliac by fragmentation, using a catheter and forceps. The lower limb was already gangrenous, and amputation was performed four days after the arteriotomy.

In the same year SCHIASSI extracted an embolus from the femoral artery, and amputated through the thigh four days later.

In 1911 two cases appeared in the literature. PROUST removed an embolus from the femoral artery 12 hours after its impaction. The patient died the following day.

MOSNY and DUMONT removed an embolus from the left femoral artery six hours after the onset of symptoms. The limb did not become gangrenous.

In 1913 three new cases were brought to light. KEY's patient complained of sudden, violent pain in the left popliteal space, with coldness and numbness in the leg. Seven hours later the dorsalis pedis was exposed by incision and found to be empty, next the popliteal artery was laid bare and it too was found to be empty. Then the femoral was uncovered, opened, and an embolus removed. The wounds healed kindly and gangrene did not follow, although, probably as the result of ischæmia, there was slight paralysis of the peroneal muscles and some contraction of the muscles of the calf.

In MARRI's case likewise, the symptoms were referable to the foot and leg, although no arterial pulsation could be obtained lower than a point 3 cm. below

ligation of the distal arterial segment, or by implantation of the lower end of the vein into the side of the artery, with ligation of the artery below the anastomosis and ligation of the proximal venous segment. All of these substitutes for end-to-end anastomosis deflect and deform the blood stream as it passes from the artery to the vein, which irregularities in direction and form are important factors in coagulation. Further, these substitutes all lack the advantage of smoothness in the neighborhood of the anastomosis, the first leaving two pockets, and the second and the third each leaving one pocket, in which a propagating thrombus is likely to develop. Without ligation as described above, lateral anastomosis and lateral implantation of artery into vein short circuit the blood that finds its way into the vein, it being easier for this blood to follow the normal direction of the venous current than to flow towards the periphery. Lateral implantation of vein into artery, without ligation of the artery distal to the anastomosis, and lateral anastomosis with ligation of the vein proximal to the anastomosis, may seem to possess some elements of innocuousness, in that while part of the blood is diverted to the vein the circulation in the artery is not suppressed, thus permitting it to carry nourishment as far as it is patent. This plan for dividing the arterial current is a compromise between a frank effort to reverse the circulation and "watchful waiting," and is less likely to succeed than either. It predisposes to thrombosis in the artery because of the decrease in intra-arterial pressure consequent upon the leak at the site of anastomosis, and because of the decrease in intra-arterial pressure the blood which passes through the artery is less apt to permeate the capillaries. Further, the amount and the force of the blood diverted to the vein are necessarily less than when the whole arterial stream is directed into the vein, and the blood so diverted, instead of penetrating to the venous radicals, escapes into the returning collateral veins through the first anastomotic branches, unless in the meantime it solidifies into a thrombus.

3 *Arteriotomy*, for the purpose of removing an embolus, was attempted first by Sabanajew in 1896. The embolus, which was supposed to be in the femoral artery, was not found, however, and the limb was amputated at a lower level.

The first report of a successful embolectomy was made by the author to this Academy in May, 1907.

A man, aged sixty-one years, was suddenly stricken with excruciating pains in the right foot, followed by gangrene of the foot and the lower two-thirds of the leg. Pulsation could not be felt in any of the vessels below the bifurcation of the femoral. Thirty-six hours after the onset of the pain the femoral artery

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reacted to light. There was no paralysis of the tongue or face, no jaundice, and no enlarged lymph-glands. The tongue was heavily coated, the thyroid gland distinctly palpable. There was slight impairment of resonance and increased harshness of the breath sounds over the apex of the right lung. The heart was enlarged and very irregular in action, the apex beat diffuse, feeble, and in the sixth interspace, about 13 cm from the median line. Over this point a presystolic thrill and murmur were present. The radial arteries were slightly atheromatous. No abnormalities were discovered in the abdomen. Pulsation of the abdominal aorta could be made out by palpation. Pulsation could not be felt in the external iliacs, or in any of the arteries in the lower limbs. The right foot was black and shrivelled, the lower two-thirds of the right leg purplish, with loosening of the epidermis and bleb formation. The left leg was painful, tender, useless, warm (because of the presence of external heat), and pale, except over an indurated area, about two inches in diameter, just external to the middle of the tibia, where the skin was reddened and œdematous. The urine showed a trace of albumin but no casts, the blood a negative Wassermann reaction and 21,600 leucocytes (polymorphonuclears 84 per cent, hyaline 5 per cent, lymphocytes 10 per cent, eosinophiles 1 per cent). There was no fever.

In view of the advanced and extending gangrene in the right leg, with only prodromal symptoms of gangrene in the left leg, it was thought that an embolus had lodged in the right femoral artery sometime preceding the impaction of a second embolus at the bifurcation of the aorta, or that an embolus had been arrested at the bifurcation of the aorta, which embolus had completely occluded the right iliac artery and at first only partly occluded the left iliac artery, the obstruction of the latter vessel becoming complete at a more recent period as the result of a superadded thrombus proceeding from the embolus. As no induration could be felt along the right femoral artery the second explanation seemed to be the better, and indeed proved to be the correct one. The red indurated area in the left leg was considered to be due to a small embolus from the heart, or from the clot accumulating at the origin of the left common iliac artery.

Although, by reason of the feeble action of the heart, it was recognized that an effort to clear the aorta would be attended by great risk, it was deemed imperative to make the attempt, not only for the purpose of saving the right thigh and the left lower extremity, but also for the purpose of relieving the cardiac embarrassment that always accompanies aortic obstruction. The alternative was abstention, gangrene of both lower limbs, and death.

The operation was performed January 5, 1914, under ether,

Poupart's ligament Thirteen hours after the trouble began the femoral artery was incised near its bifurcation, and a clot 3 cm long withdrawn from the superficial femoral, and one 2 cm long from the deep femoral Later, owing to absence of bleeding from the lower part of the superficial femoral, this vessel was milked from below upward, and a clot 15 cm long forced out through the wound This was followed by copious bleeding and the artery was then sutured After several days thrombosis recurred in the superficial femoral artery The gangrene was limited to the toes, the superficial parts of the heel, and a narrow area of skin along the inner surface of the leg The patient died two months after operation from cardiac disease and pneumonia

BAUER's case we give in detail because it is the first, and, indeed, with the exception of our own, the only one in which the abdominal aorta was opened to remove an embolus The patient was a man, aged thirty-nine years, suffering from chronic articular rheumatism and mitral disease Suddenly severe pain was experienced in both legs, which became useless, and in the lower abdomen The pulse was irregular and the face cyanotic Over both lower limbs, and over the abdomen as far as the umbilicus, the skin was cold and livid No pulse could be felt in the femoral arteries Sensation was abolished in the feet and the legs, and only partly present in the thighs and over the lower abdomen Operation was performed three hours after the onset of the embolic symptoms An incision was made in the linea alba, the small intestine drawn from the abdomen and laid on the right side of the abdominal wall, the posterior parietal peritoneum incised, and the aorta isolated After the aorta had been compressed by the finger of an assistant an incision 2 cm long was made into the artery just above its bifurcation, and the embolus extracted The arterial wound was then closed with six sutures of silk Pulsation was immediately felt in both iliac arteries The operation lasted one hour and forty minutes The embolus was about 3 cm long and had the form of a molar tooth with two short roots, the "crown" lay in the aorta, the "roots" in the iliac arteries Symptoms referable to the lower limbs promptly disappeared, except for some pain in the left foot and calf The patient left his bed on the twenty-fifth day and was discharged on the thirty-second

The history of our case of aortic embolectomy, hitherto unpublished, is as follows

S A, female, aged forty-nine years, had always been in good health up until a few years before admission to the Jefferson Hospital, when, following an attack of acute articular rheumatism, she began to suffer from dyspnoea About three weeks before operation she was compelled to go to bed because of dizziness, cough, weariness, and severe headache One week after this she suddenly lost her voice, and, although not unconscious, seemed unable to comprehend what was said to her A few days later it was noticed that she frequently rubbed both legs and especially the right one, which quickly became dark in color At the time of entering the hospital the patient was restless and constantly moaning The voice had partly returned, but only a few words could be uttered distinctly The pupils were small, equal, and

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became more feeble, and pulsation could not be felt in the left femoral artery. On the third day death occurred from cardiac weakness and pulmonary oedema. An autopsy could not be obtained.

On first viewing the patient whose history has just been related we discarded operation, because of the long time the embolus had lain in the aorta. Later, however, we realized the significance of the striking difference in the appearance of the right and the left legs and considered operation mandatory. In addition to this narrow escape from making an inaccurate "snap" diagnosis, several other features in this case stand out as highly instructive for the future building of the living pathology of embolic obstruction of the arteries, viz., the absence of occlusive thrombi in the femoral arteries, permitting them to resume their function after a number of days of inactivity, and, despite the long duration of the arterial obstruction, the absence of perceptible adhesions between the embolus and the intima, and the macroscopic smoothness of the intima, findings that allow us to entertain the possibility of restoring the circulation in the large vessels even after it has been interrupted for a long period. It may be that if our patient had survived, and the heart had contracted with a vigor approaching normal, thrombosis at the site of operation would not have occurred, it may be that cessation of femoral pulsation shortly before death was not due wholly or even principally to the alterations in the intima and the changes brought about by the arterial wound.

Notwithstanding the possibility just mentioned it cannot be emphasized too strongly that, in order to preserve a part from impending embolic gangrene, the embolus must be removed as soon after its impaction as possible, not only because of the increasing injury suffered by that portion of the intima which lies in contact with an unremoved embolus, which injury predisposes to thrombosis after arteriotomy, but also because impending quickly becomes actual gangrene, and dead tissues cannot be resuscitated. Further, in embolism of a large artery the early relief of the strain put upon the heart should be kept in mind.

The prompt diagnosis of embolism of the extremities generally presents no great difficulties, but even careful observers have, at times, been unable definitely to locate the exact site of the arterial obstruction. In four of the cases mentioned above (Sabanajew, Murphy, Handley, Key) and in another to be cited later (Stewart) the artery was incised some distance below the point of occlusion. In one of these cases the obstruction was not found, in two it was removed by indirect means

administered by intratracheal insufflation. The abdomen was opened in the median line below the umbilicus, the small intestine segregated in the right side of the abdomen, and the sigmoid pressed to the left. The iliacs were motionless, the aorta pulsated to a point near the bifurcation, at which point it was hard. The posterior parietal peritoneum was incised, and a silk ligature passed beneath the aorta at a point one and one-half inches above the bifurcation. This ligature was not tied, but it was placed so that it could be tied in the event of bleeding that could not be controlled otherwise. While an assistant compressed the aorta with a finger a longitudinal incision, extending upwards from the bifurcation for three-fourths of an inch, was made in the anterior wall of the aorta. After removing, in several pieces, a dark friable clot, evidently of recent formation, which lay beneath the incision and protruded into the left common iliac artery, the embolus itself was uncovered, and easily forced through the wound by pressure, from below upward, on the right common iliac artery, into the orifice of which the lower end of the embolus had been driven. There were apparently no firm adhesions between the obstructing mass and the intima, which appeared to be smooth and undamaged. The embolus, or perhaps we should say the embolus with the old thrombus which had gathered about it, measured 3.1 cm. by 1 cm., weighed 75 gramme, and was bullet-shaped, the distal end being bluntly rounded, the proximal end irregular, as though a portion had been broken off. The ends were dark red in color, and separated by a white band, 7 cm. in width, which sent a narrow prolongation toward the proximal end. After milking several more small fragments of clot from the left common iliac, pressure on the aorta was relaxed for an instant, in order to wash any remaining coagula through the wound, and the aorta closed with a continuous through-and-through silk suture, over which a second continuous suture, including the outer coats only, was inserted. The posterior parietal peritoneum was drawn together with a continuous suture of catgut, the abdominal wall with interrupted stitches of silkworm-gut.

The operation, which lasted about one hour, had little immediate effect on the patient's general condition. The temperature remained normal, the respirations continued at the rate of 40 to the minute, and the pulse, which could be felt in both femoral arteries, was slightly accelerated, varying, as nearly as could be estimated, between 75 and 130. On the following day the pulse failed in the right femoral artery, the temperature rose to 101°, a small quantity of bright red blood was coughed up, and numerous moist râles could be heard over the chest. On the second day dulness appeared over the lower lobes of both lungs, the heart

benefit has followed evacuatory arteriotomy, the procedure has attained a permanent place in operative surgery, and should be resorted to more frequently in the future with increasingly beneficent results. Aside from the technic necessary for successful angioplasty, and in addition to an early accurate diagnosis followed by immediate operation, the best results after embolectomy are likely to be obtained in a young patient with young arteries and a strong heart. Further, since obstruction is, generally speaking, more dangerous in a large than in a small artery, and since operation is easier upon a large than upon a small one, the greater the size of the affected vessel the more gratifying the results.

Arteriotomy for thrombosis was performed first by Lejars in 1902. His patient, a man aged twenty-six years, developed thrombosis of the femoral artery and gangrene of the foot following a severe contusion of the left inguinal region. Six days after the accident the artery was opened, a thrombus removed, and the artery sutured. Thrombosis recurred, and the leg was amputated below the knee. In 1905 we attempted a similar operation on the femoral artery with a similar result, as will be related in the next section of this article. In 1908 Lecène, and in 1909 Ranzi, each opened the brachial artery, the former for so-called spontaneous thrombosis in a tuberculous subject, the latter for traumatic thrombosis, in each instance the thrombosis recurred.

The results in these cases, with the knowledge of the lesions occurring in traumatic and "spontaneous" thrombosis, force us to the conclusion that simple removal of the thrombus is useless, or worse than useless. The cause of the thrombosis, *ie*, multiple fissures in or curling up of the intima (following a contusion) or endarteritis, is not suppressed, indeed, in view of the additional injury perpetrated by arteriotomy, the conditions are rendered more favorable for coagulation in the vessel.

4 *Resection* of a contused and thrombosed segment of an artery, followed by end-to-end union, would, if the vessel were healthy, offer as fair a chance for re-establishment of the circulation as circular arteriorrhaphy for accidental wounds, which operation we have on several occasions performed with success. Unfortunately, in many of the cases designated traumatic thrombosis injury is only one, and not always the chief, contributing factor, in these cases the artery is already diseased, and suffers obliteration from a contusion that might have failed to rupture the intima of a normal artery. Our only experience with resection for traumatic thrombosis was obtained in June, 1905, and related in this Academy in May, 1907.

through the original incision, in the other two by a subsequent incision directly over the clot. An accurate diagnosis cannot be made from the symptoms of ischæmia merely. Pain, according to our observations, is acute in the region deprived of blood, and, despite the usual teaching, absent or trivial over the site of the obstruction in the artery. Pallor, fall of temperature, hypæsthesia, and paresis followed, in the event of local death, by the discoloration of gangrene, anæsthesia, and paralysis likewise are limited to that portion of the limb in which the circulation is arrested. All of these symptoms are indicative of ischæmia solely, and the area of ischæmia never reaches the level of the arterial obstruction. The reasons for this, although obvious, are often overlooked, and the site of obstruction is thought to be much lower than it really is. If the affected artery can be palpated there is no excuse for a mistake in the localization of the obstruction. At the site of obstruction the artery may be hard and tender, above this point it pulsates, below it does not pulsate. If the site of obstruction cannot be palpated one may find pulsation in the vessel or its superficial branches at a higher level and fail to find pulsation in the vessel or its branches at a lower level. These observations, with the knowledge of the usual site of embolic impaction, *i e*, where the vessel suddenly diminishes in size as the result of giving off a large branch or bifurcating, will generally suffice to determine with fair accuracy the point of occlusion. If the artery is exposed by incision at the suspected point and found to be pulseless throughout the length of the incision the artery should not be opened in this situation to determine whether it is empty or not (palpation suffices for that) or to permit the passage of probes or catheters, both of which are dangerous in that they injure the delicate lining membrane of the artery, but the vessel should be followed by lengthening the incision in the overlying tissues, or by making another incision, until a point is found above which there is active pulsation. The artery may then be incised, evacuated, and, with due regard to the rules laid down for *angiorrhaphy*, sutured.

Arteriotomy for embolism, despite its rational and seductive character, must, of necessity, be followed by many disappointing results. All of the patients thus far operated upon were suffering from cardiac disease, most had atheromatous arteries, and in at least five cases there were evidences of previous embolism of arteries other than the one operated upon. Because of this tendency to embolic showers one can never be sure that the embolus that he is extracting is the last one to be thrown into the circulation. Notwithstanding these gloomy reflections we believe that, in view of the five cases in which undoubted

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ful, simply transfer the danger of ischæmia from one part of the patient to another, or, if an obliging friend or relative would surrender the needed bit of vessel, from one individual to another, an arterial graft would necessarily have to be taken from a fresh cadaver or from one of the lower animals. So far as we are aware only one attempt, which failed, has been made to transplant a segment of artery from a fresh cadaver to a living individual, and that by Delbet, who thus filled a gap between the ends of the femoral artery, after the excision of an aneurism. Owing to the cytolytic effect of the blood and the body juices on alien tissue, homoplastic transplantation, particularly from a cadaver, and heteroplastic transplantation would seem to be of little promise in vascular surgery, in which even slight degenerative changes in the vessel wall are sufficient to induce thrombosis.

Whether autoplasmic venous transplantation, which at once suggests itself as a simple method for overcoming the difficulties mentioned above, will prove reliable or not can be determined only by the results which future trials may bring to light. At the present time, however, the remarkable and stimulating experiments of Carrell, and the favorable clinical reports of venous grafting for conditions other than vascular obstruction, encourage the hope that a portion of a vein might be induced to functionate permanently for a thrombosed segment of an artery. In 8 of the 13 cases thus far published (Goyanes, Omí 2, Tuffier, Pringle 2, Mantelli, Lexer 2, Goecke, Krause, Enderlen, Pirovano), in which a venous graft was employed to replace a corresponding extent of artery (popliteal, femoral, brachial, axillary) that had been excised for aneurism or malignant disease, the immediate results were satisfactory (Moure).

Which vein should be chosen for transplantation depends upon the artery involved. If the artery has two *venæ comites* one of these could be selected. If there is only one venous satellite it should, as a rule, be spared, because in the event of failure both artery and vein would be obstructed. If the companion vein must be preserved the surgeon might employ a vein which does not accompany an artery, *e g.*, the saphenous or the external jugular, or one of the *venæ comites* of an artery other than that affected.

It should not be forgotten that a venous transplant containing valves must be placed in such a way that the valves will not interfere with the passage of blood through the transplant. Another matter, to which attention should perhaps be directed, is the support of the walls of the transplant. Under the impact of the arterial stream the grafted vein dilates to twice the size of the artery, thus causing the blood to

The patient was a man, aged sixty years, with mitral regurgitation and advanced atheroma. Twelve hours after a contusion of the left inguinal region he complained of severe pain, first in the popliteal space and later radiating down the leg to the foot and toes, which pain was followed by the prodromal symptoms of gangrene. The femoral artery could not be palpated because of the swelling consequent upon the contusion. Owing to this fact, to the absence of ischæmia in the thigh, and to the seat of the initial pain, we made the mistake to which we called attention in an earlier paragraph, and concluded that a large clot embolus had been swept from the point of injury and lodged at the bifurcation of the popliteal artery, consequently about 24 hours after the injury we opened the popliteal artery and, finding no clot, passed a probe gently up into the vessel for about six inches, without encountering any obstruction, thus committing, according to our present ideas, two more mistakes, *i e*, opening an empty artery to see if it were empty, and extending the injury to the intima by probing the superjacent segment. After suturing the popliteal artery, the femoral artery was opened and the thrombus removed. It was then found that, like a valve, a calcified portion of the intima had been turned into the lumen of the vessel, probably occluding it one-half. The atheromatous plate was removed and the artery sutured. As pulsation below the injured point ceased almost immediately the arterial sutures were removed, the new thrombus extracted, and the artery resutured. After a brief period the thrombosis recurred. The injured portion of the artery was therefore excised and an end-to-end anastomosis performed. This likewise failed to reestablish the circulation and the gangrene progressed rapidly, finally necessitating amputation through the thigh. The patient recovered.

The only hope of success in arterial resection for "spontaneous" thrombosis would be in a case in which the causative lesion is a narrowly limited band of endarteritis, in all other instances of "spontaneous" thrombosis the tendency to coagulation would only be accentuated by contact of the blood with an arterial wound.

The amount of artery that may be excised, without rendering circular arteriorrhaphy impossible of execution, varies somewhat with the situation, in the neighborhood of joints, flexion of the limb can be utilized to diminish tension on the anastomotic suture, in regions in which the artery is bound to the surrounding tissues by branches anastomosis, after the removal of a large extent of artery, would be impracticable without severing these branches, an expedient that would generally be contra-indicated. Enderlen was able to approximate the ends of the popliteal artery after resecting 4 cm for aneurism, Kummel, the ends of the femoral artery after resecting 5 cm during the excision of a carcinoma of the inguinal region.

The length of the resected segment could be greatly extended if, instead of directly uniting the ends of the artery, a section of another vessel were interposed between these ends. Since to repair a large artery by sacrificing another artery of equal size would, even if success-

GALL-STONES

A STATISTICAL STUDY OF CASES OCCURRING AT THE BOSTON CITY HOSPITAL

By J C HUBBARD, M D

AND

A R KIMPTON, M D

OF BOSTON, MASS

THE material for this paper is culled from 400 cases of gall-stones entering the surgical wards of the Boston City Hospital in the years 1907 to 1913, 6 years. The diagnoses of gall-stones, cholecystitis, empyema of the gall-bladder, etc., were made. Only such cases have been used in this study in which stones were found at operation, 226 cases. The remainder were either sent home unoperated or were operated upon, and no stones found.

There were 220 cases operated upon, of whom 55 were males and 182 females, the proportion being one male to 3.3 females. This preponderance of women is real, for to the surgical wards as a whole two men are admitted to every woman. In the forty-ninth report of the hospital the admissions for surgical diseases were 3772 men and 1718 women. The ages of the men fall into decades as follows

20-30	5
30-40	8
40-50	20
50-60	7
60-70	6

The youngest was 20, and the oldest 66

The ages of the women were

10-20	3
20-30	17
30-40	55
40-50	38
50-60	30
60-70	12
70-80	2

The youngest was a girl of fifteen and the oldest seventy-eight. Because of the youth of the girl I append her history

swirl in eddies and, as in aneurism, predisposing to thrombosis. Efforts have been made to prevent this dilatation by turning the vein back on itself, like a cuff, and by suturing the surrounding tissues over it. We suggest a third method, which might be employed in suitable cases of thrombosis. Since in many instances of intravascular coagulation the intima alone is at fault, it has occurred to us that, instead of resecting the artery, its internal coat might be peeled out, and replaced by a piece of vein. This would leave the outer coats of the artery as a firm support for the vein, and the vein would form a new lining membrane for the artery. In some cases of traumatic thrombosis it would probably not be necessary to remove even the tunica intima before placing the vein in position.

5 *Catheterization* of the arteries of a stump left after amputation for arteriosclerotic gangrene, in order to remove clots and thus minimize the risk of necrosis of the flaps, was suggested by Severeanu in 1894. As the passage of catheters and probes into an artery can serve only to injure its delicate endothelial lining and encourage thrombosis, we believe the procedure to be harmful rather than beneficial.

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Pain of severe type was practically always a prominent, one might say the prominent, symptom, occurring in 212 cases. Its situation varied considerably. By referring above one will see that the right hypochondrium, 88 cases, and the epigastrium, 70 cases, are the two most common sites. It is of interest, however, to note that it may occur on the left side. Obviously a sufficiently enlarged gall-bladder may give rise to symptoms in the right iliac fossa.

Pain radiated to back 46, right shoulder 24, epigastrium 5, right hypochondrium 2, both shoulders 1, between shoulders 4, right side 1, chest 2, general abdominal 6, lumbar region 4, sternum 2, axilla 1; pelvis 2, left side 1.

In 101 or 46 per cent of the cases having pain as a symptom, the pain is described as radiating to other parts of the body after having become intense at its starting point. The regions most referred to are, first, the back, 46 cases or 45 per cent, and, second, the right shoulder, 24 cases, 23 per cent. By referring above it is seen that occasionally the pain radiates to any portion of the thorax or abdomen.

The second prominent symptom is vomiting, present in 137 cases or 62 per cent, varying from mild to severe, persistent and most distressing. Rarely the vomiting contains some blood. The vomiting is often said by the patients to bring temporary relief.

The third symptom in order of frequency is jaundice. Jaundice varying from a yellow discoloration in the eyes to a definite yellow tinge to the whole body is mentioned in the history or physical examination in 107 cases or 48 per cent. The site of the stones is of special interest in these cases of jaundice. Of the 107 jaundiced persons 70 had stones in the gall-bladder only, 25 had stones in the common duct only or in addition to stones in other portions of the biliary tract, 9 in the cystic duct alone, or in conjunction with stones elsewhere, and in 3 the stones are described as being in the "ducts." These figures impress the fact that the presence or absence of jaundice gives no real aid in determining the situation of the stone. The presence of jaundice in a case should impress on one, however, the importance of a careful examination of the common duct, for but 3 out of 25 cases where a stone was present in the common duct were free from jaundice.

Chills occur very infrequently, 9 times in the whole series of 226. When present, however, they are of considerable importance. In every one the gall-bladder was acutely inflamed, the description being "inflamed," "gangrenous," "perforated."

The character of the stools was mentioned in but a few of the cases, 14 clay or white, 2 light colored. A slight detailed study is of interest

547-208 Three days before entrance an attack of pain in the upper abdomen accompanied by vomiting Jaundice for three days Several similar attacks during past year Tenderness and spasm in right upper quadrant At operation about fifty stones were found in a distended gall-bladder Cystic duct also contained stones

From a comparison of these tables of ages it is readily seen that a majority of the male cases occur in the fourth decade, and that 60 per cent of the cases come between 30 and 50 years A majority of the female cases came, however, one decade earlier, between 30 and 40 years Nevertheless, 60 per cent of them also fall between the years 30 and 50

Considering both males and females together out of 220 cases, but 3 came before 20 years of age and but 25 before 30 years, and only 20 after 60 years It is, therefore, evident that gall-stones are most common at the period of adult age, 30-60 years

Etiology—In this series 137 out of 182 women were married, 75 per cent The surgical records of the hospital have been examined to determine the normal, as it were, proportion of married to single women who enter the hospital, 62 per cent were found to be married Hence, married women seem slightly more liable to gall-stones than unmarried Not quite half of these women are credited in the hospital records with having had children Judging from the size of the ordinary family of the hospital patient class this proportion is too small, and I feel sure that this detail in the histories was overlooked

Typhoid is mentioned as having been present in the past history of 25 cases—12 males, 13 females The percentage, however, of men who previously have had typhoid is much greater than that of women, 21 per cent for the men and but 7 per cent for women

Indigestion for some time previous to the operation had been sufficiently bothersome to the patient to cause mention by him in 30 of the cases Attacks, which in view of the present more definite attack might be called previous attacks, though perhaps unrecognized at the time, occurred in 127 Hence digestive upsets varying in severity from chronic to acute, severe enough, however, to have been noted by the patient, may be found in the histories of 157, more than two-thirds of the cases

Pain—Right hypochondrium 88, epigastrium 70, right side 10, general abdominal 12, right iliac 9, back 6, right shoulder 3, left lower quadrant 3, left upper quadrant 2, umbilical 1, left side 1, right hip 1, between shoulders 1

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of the common duct, a contraction of the gall-bladder signifies that the obstruction is due to stone; a dilatation of the gall-bladder, that the obstruction is due to causes other than the stone"

In this series of cases of jaundice where a stone was found in the common duct, the bladder was contracted 9 times and distended but 3 times

Cholecystostomy was performed in 177 and cholecystectomy, complete or partial, in 24 cases. The records are incomplete in the remainder. In this place I have no comment to make on the comparison between two procedures.

The convalescence in the vast majority was quite uneventful. The two complications which appeared were sepsis and pulmonary troubles. When it is remembered how frequently the gall-bladder was inflamed or contained pus, it is surprising to learn that but 12 cases had a convalescence complicated by sepsis. The sepsis usually came in the abdominal wall, rarely as a collection of pus about the gall-bladder.

Pulmonary complications developed in 14 cases, and in a majority of these caused death. A more detailed review of this will follow.

The immediate subject matter of this portion of this review is collected from 31 cases who died after operation in the hospital.

When one comes to an analysis of the cases of this series dying in the hospital, the mortality is excessive. A further study of them, however, shows that some belong to the class of surgical emergencies. Although it is scarcely fair to the statistics of gall-stone operation to add them, we have done so, inasmuch as in the hospital records they were classed as deaths following gall-stone operation. One word before considering the cases more in detail. The Boston City Hospital draws its patients from a large city which has its proportion of ignorant, worn-out, underfed individuals, who are poor surgical risks. The death of a few such patients will always keep the mortality rate of such a hospital high.

Thirty-one cases died in the hospital as a result, or in spite of, operation, 9 were men, 22 women, of these 18 had been married. The ages of the women varied from 30 to 78, of the men from 28 to 72. They fell into decades as follows:

Age	Women	Men
20-30	0	1
30-40	7	1
40-50	5	0
50-60	6	1
60-70	1	5
70 plus	2	0

In the 14 where the stools were described as clay-colored or white, stones were found at operation in the common duct in 5 cases, and no stones were found in the common duct in 8 cases. In 5 of these 8 the subsequent history is known. One well for 22 months. One well for 14 months, but has had one attack of indigestion. One well for $2\frac{2}{3}$ years. Previously to that, however, the sinus kept breaking open. One passed a stone from the sinus while convalescent. Well now almost 4 years. One still having attacks. In the two cases where the stools were light colored, one had a stone in the cystic duct, and in the second no stones were found in the ducts. The presence, therefore, of clay-colored stools furnishes suggestive, though not positive, evidence that a stone is in the common duct.

In the presence of gall-stones the most commonly noticed signs on physical examination are tenderness and spasm, frequently associated, over the gall-bladder region, rarely occurring separately, one without the other.

Tenderness and Spasm Together—Right upper quadrant 107 cases, right side 3 cases, epigastrium 3 cases, right lower quadrant 4 cases, general 1 case, left upper quadrant 1 case.

Tenderness Alone—Right upper quadrant 56 cases, right side 3 cases, epigastrium 1 case, right lower quadrant 2 cases.

Spasm alone without tenderness in 6 cases.

A mass in the abdomen was present in 49 cases with a questionable mass in six additional. The mass was situated anywhere on the right side.

The liver was palpable in 23 cases.

At operation adhesions were noticed in 54 cases, 28 per cent.

This is of interest in its relation to the diagnosis of gall-stones by X-ray (*Surg, Gyn and Obstetrics*, February, 1914, Cole).

Gall-Bladder—Pus 28, contracted 23, distended 54, inflamed 5, gangrenous 4, perforated 5.

At operation pus was present in the gall-bladder in 28 cases. It was found in both contracted and distended bladders. A contracted bladder occurred in connection with a stone in the common duct more frequently than does a distended bladder. Of the 23 cases of contracted bladders, 9 or 38 per cent had stones in the common duct, while in the 54 cases of distended gall-bladders but 4 or 7 per cent had stones in the common duct.

While the number of cases of jaundice with stone in the common duct where the condition of the gall-bladder is mentioned is small, in general, it is in accord with Courvoisier's law as given in *Keen's Surgery*, vol III, p 1063. "In cases of chronic jaundice due to obstruction

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and the common duct plugged. Tube was fastened into the bladder and another into the duct. During convalescence enough gravel was discharged to plug the drain tube. The sinus sloughed, a fecal fistula developed and the patient died on the ninth day.

Another case developed erysipelas 13 days after operation and died six days later.

In two cases (150-140 and 524-182) a malignant mass was found at autopsy or operation. In one, a married woman of forty-eight years, with left-sided pain, clay-colored stools and jaundice, a stone was found in the common duct with a malignant mass in the duodenum. A cholecystenterostomy was done and the patient died in three days. No definite cause given. The second case was that of a man fifty-four years, with jaundice and enlarged liver and spleen, with stones in the gall-bladder, cystic and common ducts. He developed acetoneuria and died on the thirteenth day. At autopsy a cancerous gall-bladder and stones in the hepatic duct were found.

Cerebral thrombosis, acute dilatation of the heart and dilatation of the stomach account for four deaths.

The two most common causes were pulmonary complications and a gradual progressive weakness, finally ending in death.

Among the 31 cases the convalescence was complicated by pulmonary troubles in 8 cases, ending in death in all.

In the following four cases such a fatal complication might be, perhaps, excusable because of the condition of the patient.

CASE 550-74 —A man of sixty-two entered the hospital in a very shaky condition, having been drinking. The operation was postponed for five days, when it was thought best to do it. There was pus in the gall-bladder. He was a poor risk but the risk had to be taken. He developed pneumonia and died in three days.

Another case (530-50), of a fat woman aged sixty-seven, who had a cardiac murmur and a fibroid of the uterus with a history of various troubles reaching back a number of years, died two days after operation with evidences of a pneumonia.

Another case (560-226) was that of an eighty-seven-year-old woman with an inflamed gall-bladder.

A fourth (515-86) had pus in the abdomen at operation—woman of fifty-one years. Had had typhoid and previous attacks of colic. Seven days before entrance had an attack of epigastrium pain which was referred to right hip and shoulder, vomited, became jaundiced. Entered hospital with temperature of 103°, pulse of 100, with a spastic abdomen. Rigidity was marked in right upper quadrant. As soon as the abdominal cavity was opened pus was found. Liver had fibrin on it. Bladder contained pus and stones. She died in 20 days from pneumonia.

The presence or absence of former attacks of gall-stones, of typhoid fever, the character or situation of the pain, its reference to other parts of the body when seen in tabular view show no reason why these cases should have died while others recovered

The patients in this series, however, were more severely diseased than those who recovered, as evidenced by the frequency of chills, jaundice, enlargement of the liver and presence of a palpable mass in the region of the gall-bladder. Among the 31, 5 had chills, 18 were jaundiced, 5 had enlarged liver, one having in addition an enlarged spleen, and in 5 a palpable mass in the gall-bladder region was present, while in an additional one there was a questionable mass. The condition of the gall-bladder was found at operation and the situation of the stones also showed the greater severity of the process in these than in those who recovered. The gall-bladder was inflamed, neurotic, perforated, or contained pus in 8 cases, and stones were found in the ducts in 16 out of 31, in conjunction with stones in the gall-bladder in 9, and in the ducts alone in 7.

The perforated cases were as follows

178-32 Male, aged sixty-two. Previous attacks four and six years ago. One week ago attack of severe pain in back. Improved until yesterday when seized with sudden sharp griping abdominal pain, not well localized, vomiting, chills, fever, abdomen distended, tender in lower right side, general spasm, dulness (both flanks). As soon as peritoneal cavity opened large amount of bile and a few small stones escaped. One large stone free in the abdominal cavity. Drained. Did not react to stimulation and died.

500-158 Woman, aged thirty-nine, married, always well until two days before entrance when doubled up by severe pain in right lower quadrant. Pain recurred, at intervals less severe. Temperature 101° , pulse 100, white cells 18,000. Pain and tenderness over entire right side of abdomen. At first refused operation. When abdomen opened, pus, bile and two small stones escaped. Gall-bladder was found perforated and contained more stones. Steadily failed and died next day.

During convalescence three cases developed sepsis in the wound, one dying as a result nine days after operation.

500-258 Woman, aged forty-two, married. Had had previous attacks, jaundiced, tenderness over the gall-bladder and epigastrium, with a questionable mass in the epigastrium, was present. On day of operation temperature was 101° , pulse 95. The gall-bladder was found distended and its lining necrotic. The bladder, ducts and liver were full of gravel. The duodenum was necrotic.

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He considers the mortality of cholecystostomy as 3 per cent and cholecystectomy as $4\frac{1}{2}$ per cent. Those figures I understand are in uncomplicated cases. If from the series in this paper the complicated cases with stones in the common ducts, cases of peritonitis and perforated gall-bladder, and cases with heart disease (18 cases among the 31), are removed, the combined mortality of cholecystectomy and cholecystostomy at the City Hospital is 5 per cent plus.

End Results—Of these operations the end results, not including those cases who died in the hospital, have been learned in 91 cases, either by letter or from personal interview. The actual number of patients operated on is at least four less, as four were operated on twice.

The length of time since operation varies according to the following table

	Cases		Cases
1-12 months	1	5-6 years	11
1-2 years	17	6-7 years	6
2-3 years	20	7 plus	3
3-4 years	19	Number of years doubtful	1
4-5 years	13		

Of the 91 cases, 74 or 81 per cent consider themselves well, cured by the original operation. Of this number 5 qualify this statement by saying that they still have some indigestion. Four cases are having trouble, not apparently due to gall-bladder disease. Three still having attacks of pain, etc., suggestive of gall-stones and one is "not well."

In the series are a few with post-operative herniæ, very few considering that the wounds have been drained. There is, however, a number who say that they have never really been well since the operation. There is nothing suggestive of gall-stones and nothing definite in history or examination is found aside from the fact that something in general physical well-being was lost and has not been regained. One died 8 months after the operation from pneumonia.

The failure to obtain a permanent primary cure is due, in the majority of cases, to stones which have been overlooked and left behind. The difficulties began at once during convalescence in 2 cases who, while still in the hospital, passed stones not removed at the operation from the drainage tube. One has been well since then, now for 3 years, 3 months. The end result of the second case was not learned. Some cases returned after discharge with symptoms warranting a second operation, by which stones were found which had been missed.

Even after deducting these four cases the percentage of 4 out of 31 post-operative fatal pulmonary lesions seems far too large. One would suspect that the more extensive operations would be followed more frequently by pulmonary complications through interference with free diaphragmatic action. If it is granted that removal of stone from a duct requires a more severe operation than from the gall-bladder, the series of cases appears to verify the above statement, for the percentage of those with stones in the ducts dying from pulmonary complications is greater than that of those with stones only in the bladder, although the actual number is smaller.

To attempt to determine why certain cases after operation progressively failed and died is even more difficult. Of these there were nine cases, omitting the two cases of perforated gall-bladder already mentioned, death coming in from one to fourteen days after operation.

One (156-96) was in a man sixty-nine years old, with pus in the gall-bladder.

Shock would account for one at least and perhaps more. 505-106, male fifty-seven years. Stone in cystic duct, drained. Eleven days after discharge readmitted, weak, jaundiced. At the second operation stone found in the duodenal wall. Never rallied from operation.

Even after deducting these cases a number are left where the cause of death as recorded in the hospital records appeared to be simply a progressively increasing weakness without any definite pathological condition which was made out clinically. This may be the condition described by Crile, in *Surgery, Gynecology and Obstetrics* for April, 1914, from which article I quote "In the common duct operation, death can rarely be attributed to the loss of bile, but is due to the gradual development of an asthenic state characterized by dulness of the mental and motor reactions, a dry tongue, partial suppression of bile, anorexia, and scanty urine, together with the impairment of the entire digestive system,—a progressive adynamic state which is extremely resistive to any known treatment." He considers this due to impairment of the nerve supply of the liver which follows the course of the vessels and common duct.

The mortality of this series as a whole is large, 31 out of 226, 13 per cent. As I said, however, earlier in this paper, certain cases are included which perhaps do not really belong here as far as the cause of death is concerned. Let us compare these figures with the mortality percentage as determined by Dr. Codman after combining the figures furnished from various hospitals.

THE SURGICAL TREATMENT OF GASTROCOLOPTOSIS *

BY JOHN DOUGLAS, M D
OF NEW YORK

THE surgical treatment of gastropptosis is not viewed with any degree of enthusiasm by the medical profession in general. It is commonly assumed that the end results attained by operation do not justify the means employed, and that, while an immediate temporary benefit may be accomplished, the condition of the patient after one or more years is not greatly improved, or may even be worse. The favorable reports of Rovsing,¹ Beyea,² and of Coffey,³ resulting from their method of gastropexy, are opposed by such statements as those of Binnie,⁴ "the condition present is one of general visceral ptosis, hence the operation is commonly futile," or of Moynihan,⁵ who writes of gastropptosis, "it is not the most important part of a more widespread disorder." It is also the contention of the majority of internists and gastro-enterologists that the condition can be cured in all cases by non-surgical methods.

In the majority of cases non-surgical treatment will effect a cure. Rest in bed, with elevation of the foot of the bed, gastric lavage (although this is said to be absolutely contra-indicated by some), forced feeding with easily digested food of high nutritive value, in small quantities at a time but frequently repeated, together with general tonic treatment, to be followed after the stomach has regained some of its lost tone by regulated abdominal exercises and the wearing of a properly fitted abdominal belt, or pad, such as that recommended by Lane and by Rovsing, or a surgical corset, frequently will greatly relieve or cure the symptoms, and a radiograph after such treatment often shows the stomach elevated to approximately a normal position.

There will be, however, a number of patients who will not or cannot carry out the long course of treatment of six or eight weeks in bed, or who are not cured by non-operative means, and corsets or belts are not of much use in the type of virginal splanchnoptosis. They are frequently patients of what are commonly called the neurasthenic type, are generally miserable, complain of vague gastric and abdominal pains and digestive ailments, and are not looked upon as favorable subjects for any operation, but if operation is performed in properly selected cases and, what is equally important, the proper after-treatment is carried out, a large number may be relieved or cured.

* Read before the New York Surgical Society, January 27, 1915

One case returned in a few days and stones were found in the sinus. The patient has been well since, five years.

Stones have been found in these secondary operations in this series in the gall-bladder and the cystic and common ducts.

One case, 1 year 10 months convalescent, developed jaundice and diabetes. Stones were found in the gall-bladder, well now for 3 years 5 months.

One patient where the stone was found in the cystic duct has been well for six years. Two cases have been well respectively 4 years 8 months and 8 years following secondary common duct operations.

That complications subsequent to discharge from the hospital may arise not due to stones is shown by the following cases.

One case returned in five months with symptoms suggestive of stone. Two years ago a secondary cholecystectomy was done. No stones were found. The patient has been well since. Two cases had the sinus open spontaneously. No more stones were found and both have been well 2¾ years. One case nine months convalescent developed an abscess below the liver.

The difficulties appear to have been caused by either too short drainage of the gall-bladder or by failure to remove at the first operation all the stones.

The conclusions which may be drawn from this review of cases are

That gall-stones occur most commonly in women of adult age, that the history and physical examination usually are suggestive of gall-stones, that the presence of jaundice and clay-colored stools is suggestive, but not indicative, of stone in the common duct, that a permanent cure in the vast majority of cases is brought about by primary operation, that the complications to be most feared are pulmonary, and that the mortality is slight.

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and all the symptoms of gastro-intestinal stasis and intestinal toxæmia may occur. Frequently, the patients have been treated for a prolonged period for indigestion and chronic gastritis, or the appendix removed for chronic appendicitis. Radiographic examination of the stomach will show, in most cases, the type of stomach called by Satterlee and LeWald the "water-trap stomach," in which the vertical diameter of the stomach is abnormally long, the greater curvature being three to six inches below the level of the umbilicus, the lesser curvature even being well below this level, while the second portion of the duodenum, being fixed by the gastrohepatic ligament and its retroperitoneal attachments, holds up the pylorus.

Such a picture readily explains how pain may result from the weight of food pulling on the fixed points at the fundus and the duodenal attachments, and, in the presence of a weakened stomach musculature, the failure of the stomach to lift all of its contents up over the long pyloric arm and empty itself in the normal time, thus accounting for the residue found in the stomach at the end of six hours after the bismuth meal.

In the consideration of the possibility of improving or curing this condition by surgical procedure, it is to be reiterated that operation is not to be resorted to unless medical means fail, or, perhaps, in working women who are unable to give up the long time in bed with careful nursing and feeding necessary to cure the *severe* type of cases. However, the conclusions of Dr. LeWald, director of the Rontgen Department of St. Luke's Hospital, are worthy of most careful consideration in view of Dr. LeWald's neutral position between medicine and surgery, and his experience as a pathologist and rontgenologist. Dr. LeWald* states his position as follows, based upon a most careful study and analysis of over two hundred cases.

"The indications for and against operation may be summarized as follows.

"(a) Care should be taken not to operate on a simple, ptosed stomach, with or without dilation. This rule is subject to occasional modifications.

"(b) The typical water-trap stomach of mild degree which does not yield to medical treatment should be operated on.

"(c) The typical water-trap stomach of marked degree which shows a large residue in the stomach after six hours should be operated on as soon as diagnosed."

As previously stated, operative treatment has met with strong opposition. Maclaren and Daugherty,⁷ in an article on "Pyloroptosis," reach the following conclusions: "First, position of the stomach is not

There are various theories as to the cause of gastrocoloptosis. Glenard's theory of a nutritional disease due to some vague sort of hepatic diathesis, resulting in atrophy and prolapse of the small intestine, thus depriving the stomach of its support, if accepted would hardly be a favorable basis on which to establish a cure by surgical procedure. The same may be said if we accept Stiller's theory, that the condition is due to a congenital laxity and asthenia and degeneration of all the tissues of the body. But is it necessary to accept these theories?

Rovsing divides gastrocoloptosis into two types, the virginal and maternal, the former being due to tight lacing of corsets, the latter to changes resulting from pregnancy. While both these elements may enter into the etiology in some cases, a far more tenable theory, in view of the facts that fully half the cases observed occur in nulliparous women, that narrow waists obtained by tight lacing have not been fashionable for a number of years, and that these patients rarely give any history of tight lacing, is that of Satterlee and LeWald in their articles on "Water-trap Stomach." Their theory embraces first, a congenital faulty development of the gastro-intestinal tract, with abnormally long mesenteries of the stomach and colon and a long pelvic colon, plus bad intestinal hygiene and bad habits. The greater frequency of the condition in women might readily be explained by the narrow costal arch and smaller amount of space in the upper abdomen and the broad roomy pelvis occurring generally in the female sex.

When a general visceroptosis is present, the contributing or causal factors mentioned by Coffey and others must be considered, such as improper prenatal rotation of the colon and fusion of the posterior layers of the parietal peritoneum, thus resulting in nephroptosis and cæcum mobile, the loss of abdominal fat, changes in intra-abdominal pressure and the assumption of a position in standing and walking which lessens the natural support of these organs normally fused to the posterior abdominal wall.

The symptoms complained of are those due directly to the ptosed stomach, that is, pain, usually in the left hypochondrium or epigastric region, a dragging sensation, symptoms of indigestion and frequent eructations of gas. Rovsing calls attention to the fact that the distress caused by the ingestion of food is in proportion to the quantity of the food rather than the nature or the digestibility of the meal taken. These gastric symptoms are frequently relieved by lying down. Vomiting is usually not a marked symptom, but in some cases hæmatemesis occurs, leading to a faulty diagnosis of ulcer. As secondary symptoms, constipation, malnutrition, loss of weight, loss of appetite, headaches, anæmia,

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the stomach, which begins to empty normally, but finally appears to relax and a residue remains after the normal emptying time

I further believe this view of the relationship between these predisposing and exciting causes (position of the stomach and atony of its walls), associated with or causing the symptoms of gastroptosis, aids in the understanding of the relation between the position of the stomach and the symptoms apparently caused thereby. That is, it is frequently stated that gastroptosis exists without symptoms, therefore, it does not cause symptoms, so why interfere with it as it may be a normal position for that individual's stomach. It is granted that gastroptosis may exist without symptoms just as astigmatism, or eye strain, may exist without symptoms until, just as in the eye condition, the patient's general health, or nervous or muscular strength, becomes overtaxed, then the normal functional activity fails and the lesion which had previously been present becomes manifest by the symptom exhibited.

If a hypertonic condition of the stomach wall can be attained by non-surgical treatment, the stomach may pull itself up out of its ptosed position, but this result is often difficult to attain by forced fat feeding, posture, etc., unless the treatment extends over a long period; or in other cases there may be sufficient muscular power to empty the stomach even while it remains low, just as cardiac hypertrophy compensates for a valvular lesion.

If, then, surgical treatment is to be attempted or is justifiable, what is the best means to employ?

The ideal operation would be the one which would hold the stomach in place and interfere least with its physiological functions. This is difficult to accomplish, many believe it impossible, and for that reason have given up attempts at gastropexy, and, if any form of operative treatment is attempted, perform a gastro-enterostomy with or without pyloric occlusion.

The methods of gastropexy employed are either the direct or indirect. In the direct method of Rovsing, the parietal peritoneum of the anterior abdominal wall and the anterior stomach wall are scarified with a fine needle, the latter between three linen sutures passed in and out through the seromuscular coats of the stomach wall, parallel with the lesser curvature and about 2 cm apart. The threads are then led out through the abdominal wall and tied over a glass plate. The theoretical objections to this operation are twofold. First, that a suture passed through a muscular organ such as the stomach, undergoing continual peristaltic movements, might be expected to cut out within a short time, although the scarification of the two contiguous peritoneal

important, that the pylorus is practically a pelvic organ, second, the principal function of the stomach is mechanical, third, the beginning or first symptom of the so-called neurasthenia is due to gastric atony, fourth, postural drainage and fat feeding, temporarily at least, cures these patients, fifth, from our present experience, we believe that operations on the atonic stomach to change its position and help its drainage have still to be proven advisable, because no operation will take away the muscular atony but will rather aggravate it" All of these conclusions (and I believe they are those usually accepted) sound eminently logical if the premises are correct, but examination of a large number of roentgenograms shows two points which contradict the more important of these premises in many cases. First, that while frequently the pylorus is low, in the vast majority of the patients complaining of symptoms the pylorus is not low or a "pelvic organ," but is kept up in place by the duodenal attachments, or is only slightly lower than normal, while the greater and even the lesser curvature of the stomach sag down below the level of the crests of the ilium and into the pelvis, and the condition is a gastropptosis, or at least a ptosis of a portion of the stomach, and not a pyloroptosis, as it is called by Maclaren and Daugherty, and also by many others (Fig 1). It is in this class of cases that radiography shows a gastric residue six hours after the bismuth meal more frequently than in those in which a pyloroptosis allowing of drainage is present.

Second, the assumption that the position of the stomach is not important and that the symptoms are all due to gastric atony. While gastric atony is often an important element in determining the symptoms complained of, it is my belief that it is not the sole element present but bears the same relationship to the predisposing cause, *i e*, the gastropptosis, in causing the symptoms, as exists between predisposing and exciting cause in the etiology of many diseases. Radiograph examination of many cases of gastropptosis shows that frequently the stomach is not markedly atonic (Fig 1), and it would appear to me to be a fair assumption that, while if the stomach were in a normal position the stomach musculature would be sufficient to empty that organ in the normal time, in the presence of a gastropptosis of the water-trap or drain-trap type, a comparatively small amount of loss of muscular tone may render it impossible for the muscular wall of the stomach to lift the stomach contents out of the sagging portion of the stomach up over the long pyloric arm shown by the radiograph in these cases. Radiographic examination frequently, but not always, shows that immediately after the bismuth meal there are good peristaltic waves in

the pylorus into the upper angle of the abdominal wound. Numerous reports demonstrate the bad results following gastro-enterostomy for gastropotosis unless a pyloric occlusion is also done. Schultze-Berge,¹⁴ in uncomplicated cases of gastropotosis, recommends "high suture" of the stomach, which he has done in about 80 cases with good results. In gastropotosis with gastrectasia, or with scar tissue or adhesions in the pyloric region, he considers gastro-enterostomy with pyloric occlusion advisable.

Wiedhoff,¹⁵ in a study of splanchnoptosis in the Wilms Clinic, concludes that splanchnoptosis is due to diminished volume of the abdominal viscera, so that the abdominal cavity is too large for its contents. He believes the various operations for fixation of the ptosed abdominal organs by means of peritoneal folds unsatisfactory, and suggests, if methods of increasing the fat and muscular tone of the patients fail, the narrowing of the lower part of the abdominal cavity by doubling the posterior rectus sheath and overlapping the recti. This method would hardly appear to recommend itself in cases of virginal splanchnoptosis. Coffey, in addition to his fixation operation, in certain cases widens the upper part of the abdominal cavity and narrows the lower part by operation on the recti.

Schlesinger¹⁶ has employed and recommends resection of the middle third of the stomach for severe cases of gastropotosis.

The multiplicity of operative procedures, nearly all of which are open to some form of criticism, indicates that an ideal or generally accepted operation, if such a thing be possible, does not exist. The reports, however, except from those who have devised some special form of operation, are isolated and of comparatively few cases or too soon after operation to ascertain the final results, and it, therefore, seemed worth while to report on the following 10 cases operated on by what seemed to me the most simple method, after a period of from 10 months to 3½ years after operation. The operation done was shortening of the gastrohepatic omentum, with suture of the gastrocolic omentum, for a distance of 6 to 7 inches, to the parietal peritoneum of the anterior abdominal wall, about 2 inches above the umbilicus, similar to the method of Coffey. All the patients were females.

CASE I—L. E., aged thirty-one, nullipara. Severe progressive neurasthenia and hysteria for years. Periodical attacks of vomiting, sometimes every two weeks. Has lost 40 pounds. Marked constipation. Medical treatment consisting of sedatives, posture, rest in bed, rectal feedings without avail.

surfaces should allow the formation of adhesions before this occurred. Second, that if firm adhesions of the stomach wall to the anterior abdominal wall did occur, the physiological functions of the stomach would be sufficiently interfered with to cause symptoms. Rovsing's personal statistics, as a result of operation in 163 cases, showed 50.6 per cent of cures, 14.7 per cent of great improvement, 11 per cent improvement, 12.8 per cent. of slight improvement or none, and a mortality of 4.9 per cent. The results of the same operation in 93 cases by other Scandinavian surgeons showed 75 per cent cured, 9.6 per cent improved, 11.8 per cent slight improvement or none, and a mortality of 3.2 per cent.

The indirect method most employed is the method of Coffey, which combines the Beyea operation, of shortening of the gastrohepatic ligament, with suture of the gastrocolic and great omentum to the anterior abdominal wall for a distance of six or seven inches, two inches above the umbilicus, thus making a "hammock" by which the stomach is suspended. If the gastrohepatic omentum after plication were sufficiently strong to continue to maintain the weight of the stomach, Beyea's operation would be ideal, but it is frequently thin and easily stretches. It was for this reason that the Coffey operation was devised. The objection to the latter operation is that in a number of cases the adhesions stretch and the ptosis recurs, and Rovsing states that the stomach may become ptosed to the left of the area of omentum sutured to the anterior abdominal wall. Reporting on 41 cases of gastropexy according to his method, Coffey states that 26 were symptomatically cured, 9 very much improved, 4 somewhat improved, 1 unimproved (had tuberculous enteritis), and 1 died of pneumonia. Reed⁸ reports a number of successful results, with gastropexy, by a method similar to Coffey's. He makes a modified transverse epigastric incision, separates the peritoneum from the fascia along the lower lip of the wound, and, after shortening the gastrocolic omentum, sutures the great omentum to the fascia from which the peritoneum has been separated.

A number of surgeons, who do not approve of the different attempts at gastropexy, particularly those reporting in the German literature, perform gastro-enterostomy with pyloric occlusion for the relief of gastroptosis, frequently with the addition of suspension of the pylorus. For the suspension of the pylorus, the fascial strips used as a means of pyloric occlusion, as in the method of Wilms, are employed with various modifications by Goebell⁹ and Hoffmann¹⁰. Pagenstecher¹¹ and Herscher¹² use the round ligament of the liver to suspend and occlude the pylorus after gastro-enterostomy, and Mariani¹³ has sutured

Before operation. Note ptosis of stomach and atony of stomach.

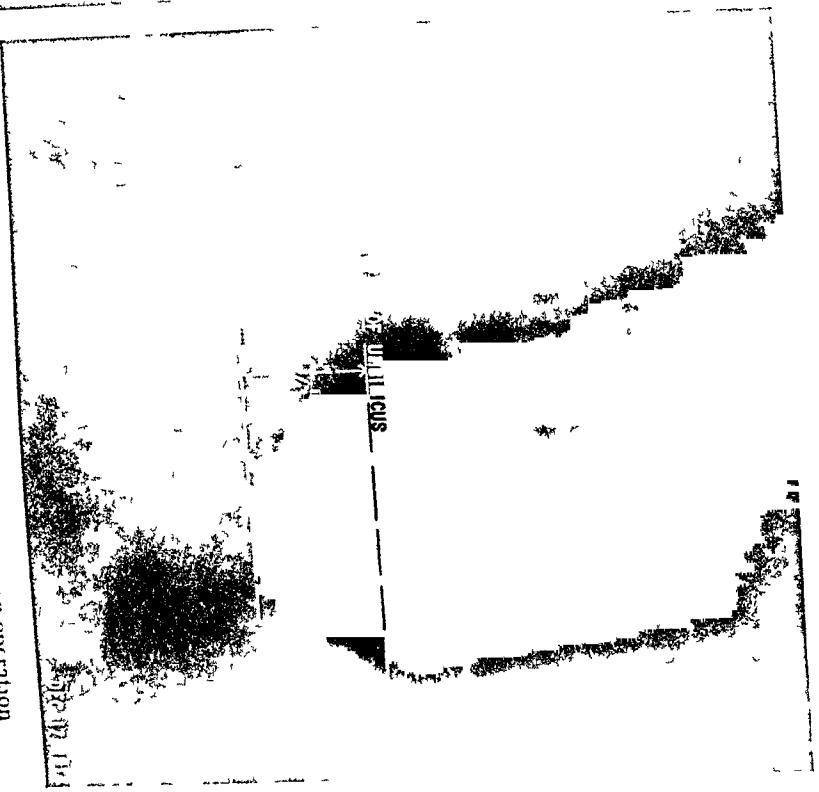
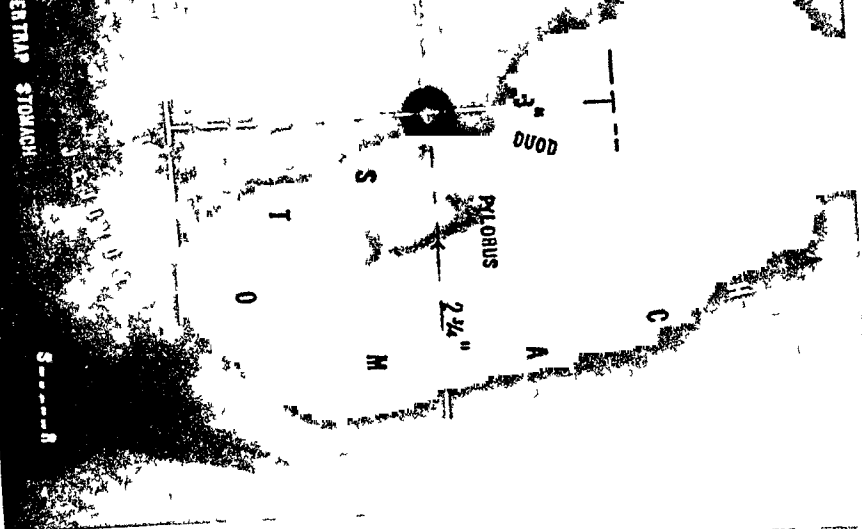


FIG 2 —Case IV Two years after suspension operation

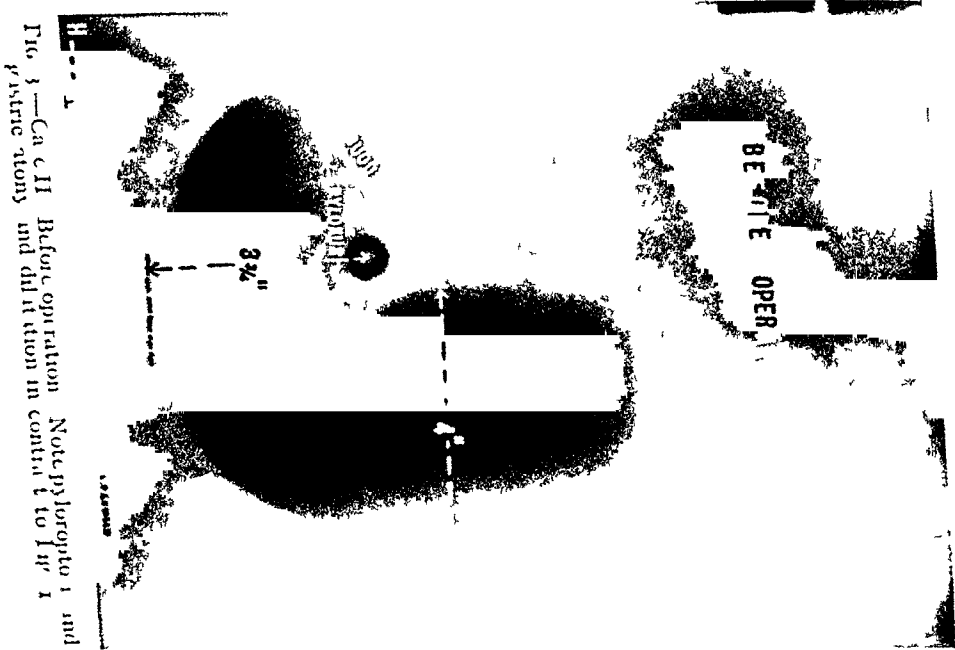


FIG 3 —Case II Before operation. Note ptosis of stomach and atony of stomach.

X-ray report showed greater curvature 6 inches below umbilicus

Operation—St Luke's Hospital, August 12, 1911 Suture of stomach to anterior abdominal wall after scarification Three sutures in gastrocolic omentum

Three and one-half years after operation patient is free from gastric symptoms and has gained 25 pounds Is still constipated, and radiograph examination two years and eight months after operation shows partial recurrence of ptosis, but to markedly less degree than before operation

The fixation operation on this patient was less complete than in the other cases

CASE II—Mrs L H, aged thirty Severe attacks of pain for two years, usually after eating Frequent eructations of gas, palpitation of the heart, marked constipation Possible attack of appendicitis five months ago

X-ray report showed greater curvature $3\frac{3}{4}$ inches below umbilicus (Fig 3)

Operation—St Luke's Hospital, May 29, 1912 Appendectomy Suture of gastrocolic omentum to parietal peritoneum

Report, February 14, 1913, 9 months after operation No stomach symptoms except occasionally raises gas Constipation improved, but occasionally takes laxative

No answer to letter recently sent

CASE III—Miss M M, aged thirty-five Pain in left hypochondrium, eructations of gas, distress after eating Does not vomit Lost weight Symptoms date back five years, after lifting a heavy woman

X-ray report showed stomach $5\frac{1}{4}$ inches below umbilicus

Operation—St Luke's Hospital, November, 1912 Plication gastrohepatic omentum Suture of gastrocolic omentum to anterior abdominal wall Double nephropexy Appendectomy.

Report, March 17, 1914, 1 year and 4 months after operation Feels well, no pain or stomach symptoms Gained 29 pounds X-ray shows stomach has again sagged $2\frac{1}{2}$ inches below position, on leaving hospital This patient, however, returned to heavy work six weeks after her operation without wearing any supporting belt or corset

CASE IV—Mrs F S, aged twenty-five For five years distress in stomach and palpitation of the heart half hour after meals, relieved by belching Sensation of being gripped in upper abdomen by a vice No nausea or vomiting Lost 40 pounds Obstinate constipation

X-ray report showed greater curvature 4 inches below umbilicus (Figs 1 and 2)

SURGICAL TREATMENT OF GASTROCOLOPTOSIS

Operation—St Luke's Hospital, December 31, 1912 Plication of gastrohepatic omentum Suture of gastrocolic omentum to anterior abdominal wall Appendectomy

Report, December 4, 1914, two years after operation Feels well No gastric symptoms Gained 37 pounds Has not taken cathartic in 1½ years X-ray shows greater curvature 1½ inches below umbilicus in normal position

CASE V—Miss J H In 1909 had constipation and indigestion. In 1910 operated for appendicitis Symptoms worse after operation Two subsequent operations for adhesions Continued to have pain after eating, cramps, frequent vomiting and obstinate constipation Weighs about 90 pounds

X-ray report showed greater curvature about 3 inches below umbilicus.

Operation—Bellevue Hospital, May 29, 1913 Showed band of omentum adherent to cæcal region pulling down stomach and transverse colon Omentum separated and sutured by row of sutures to anterior abdominal wall two inches above umbilicus

Report, December 8, 1914, one year and seven months after operation Feels well Gained 20 pounds Bowels move daily Good appetite No gastric symptoms

CASE VI—Mrs L W, aged thirty-nine, multipara History of gastric disturbance over ten years Distention of stomach and eructations after eating Constipation Operation for fibroids May, 1913 Appendix removed at that time Gastric symptoms worse since operation for fibroids

X-ray report showed greater curvature of stomach 4 inches below umbilicus

Operation—Bellevue Hospital, August 6, 1913 Plication gastrohepatic omentum Suture of gastrocolic omentum to anterior abdominal wall Patient left hospital against advice, and has been lost track of.

CASE VII—Mrs J B, aged thirty-eight, multipara Dull pain in stomach and epigastric region for seven years Frequent eructations of gas Medical treatment on and off with very little relief during that time. Frequent attacks of vomiting Operation for appendicitis seven years ago No relief In bed one month before operation to relieve gastroptosis

X-ray report, Dr. L G Cole, greater curvature prolapsed to within 1 inch of symphysis

Operation—General Memorial Hospital, October 2, 1913 Plication gastrohepatic omentum Suture gastrocolic omentum to anterior abdominal wall Falciform ligament shortened Right nephropexy

Report, December 8, 1914 Appetite good, can eat nearly

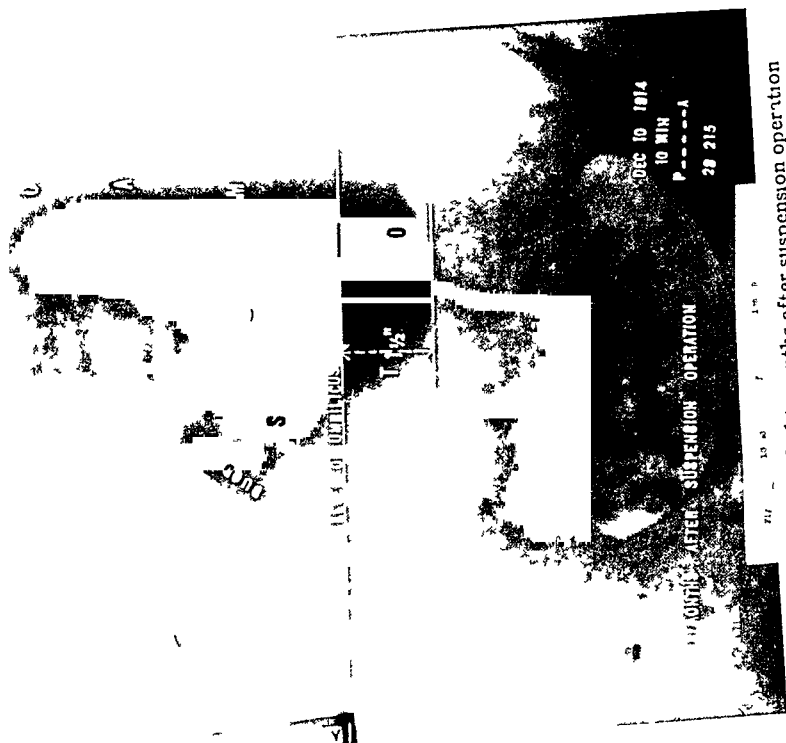


FIG 4 —Case X Before operation

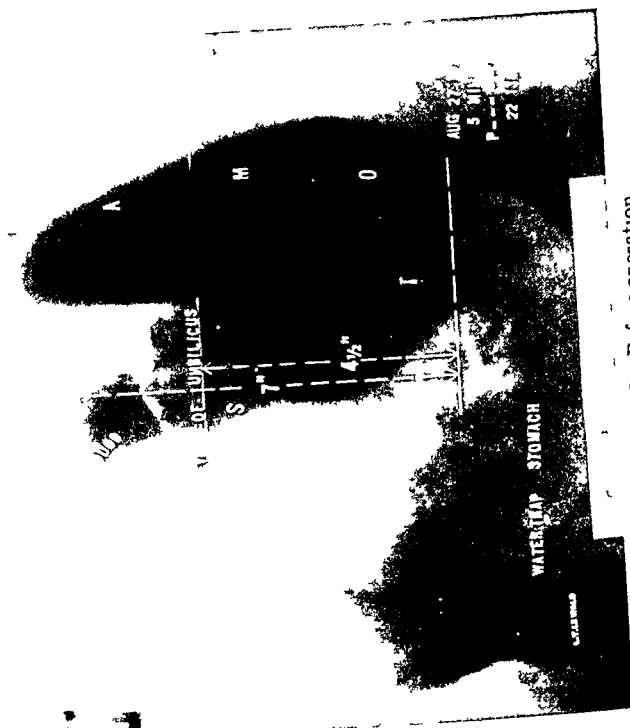


FIG 5 —Case X Light months after suspension operation

SURGICAL TREATMENT OF GASTROCOLOPTOSIS

X-ray report showed greater curvature $4\frac{1}{2}$ inches below umbilicus. Marked residue six hours after bismuth meal (Figs 4 and 5).

Operation—St Luke's Hospital, April 27, 1914. Gastrocolopexy as in previous cases. Appendectomy. Double nephropexy.

Examination, December 15, 1914: Has returned to general housework. Feels well. No gastric symptoms or pain. Gained 10 pounds. X-ray shows greater curvature $1\frac{1}{2}$ inches below umbilicus in normal position.

A summary, then, of the results in 8 cases followed up to the present time, out of 10 operated upon, shows 7 markedly improved or cured. One other patient (Case II), whom I have been unable to reach by letter, was improved when seen nine months after operation, and one patient reports herself to be no better one year after operation. There has been a gain of weight in seven cases of from 10 to 37 pounds, with an average of 23 pounds. Even the patient who reports herself unimproved has gained 3 pounds. Constipation has been improved in 5 of the 8 cases, and in 2 of the most obstinate cases absolutely cured. Two patients had previously been operated on for chronic appendicitis without improvement.

X-ray examination three to four weeks after operation, immediately before or after leaving the hospital, has shown the stomachs at that time in good position. Subsequent examinations eight months to two and one-half years after operation have usually shown the stomach has reached a lower position than when the patient left the hospital, but in no case examined was the stomach as low as previously, or very markedly ptosed, and in those cases in which the stomach remained up the best symptomatic results were apparent. Also, there was only a small or no gastric residue shown by any of the post-operative roentgenograms.

It is my belief that gastropexy alone, after the method employed above, is not sufficient to cure these cases, as it is reasonable to expect stretching of the adhesions or of the shortened gastrohepatic and gastrocolic omentum, unless every effort is made after operation to prevent this occurring. This was shown by Case III. Therefore, after operation the foot of the bed should be elevated for the three weeks that the patient remains in bed. After getting up, the patient should wear a properly fitted abdominal belt or corset, and continue for a time to sleep with the foot of the bed somewhat elevated. Constipation should be prevented by the use of Russian mineral oil and agar-agar, rather than by the use of cathartics, and the diet carefully regulated. If the kidneys are ptosed, they should be anchored at the same time.

everything Gained 23 pounds Well except for attacks of what is apparently migraine, every two or three weeks Considers operation a "great success"

CASE VIII—Mrs E K, aged thirty-six, multipara For four years has had pain in left arm and side down to foot and up to head Gets dizzy and face flushes, pain in back, ovarian region and left leg Attacks of indigestion Local symptoms due to fibromyoma uteri Hot flashes

X-ray report shows gastroptosis Distance below umbilicus not stated and plates lost

Operation—General Memorial Hospital, January 12, 1914. Gastrocolopexy as in previous cases Supravaginal hysterectomy, leaving right ovary Appendectomy

Report, December 7, 1914 Is no better Still has gastric symptoms, pains and constipation

This patient had a variety of symptoms, neuralgic pains in the arms and legs, etc, obviously not due to the gastroptosis A hysterectomy was performed for her fibroid, and gastropexy done at the same time Is hardly a fair case to judge benefit of fixation operation

CASE IX—Miss E O, aged thirty Always troubled with stomach, worst past three years Ten years ago nervous breakdown Pain and fulness in stomach about one hour after eating Belching of gas Vomiting, constipation and headaches Good appetite, but unable to eat on account of distress Symptoms relieved by lying down Treated for gastroptosis for past two years by rest in bed, abdominal binder, etc

X-ray report showed greater curvature 3 inches below umbilicus

Operation—General Memorial Hospital, February 24, 1914 Gastrocolopexy as in previous cases Appendectomy (appendix apparently not macroscopically diseased)

Report, December 4, 1914, 9 months after operation States she is greatly improved, has very little indigestion, can eat great variety of food which always upset her before, has gained 18 pounds since operation Weighs more than she ever did Still constipated Has headaches and vomits at menstrual periods, but considers "operation the best thing ever happened to her"

These last three patients live a considerable distance from New York, and it was impossible to get radiographs showing the present position of their stomachs

CASE X—Miss A P, aged thirty-seven Discomfort in upper abdomen, mostly in right side under costal margin and in epigastrium in daytime when up and at work Relieved on lying down and at night Eructations of gas, and constipation No vomiting

THE RÔLE OF GASTRO-ENTEROSTOMY IN THE TREATMENT OF ULCERS *

BY FRANK MARTIN, M D.

OF BALTIMORE, MD

PROFESSOR OF OPERATIVE SURGERY AND CLINICAL SURGERY IN THE UNIVERSITY OF MARYLAND

AND

THE ACTIVITY OF THE PYLORUS FOLLOWING GASTRO-ENTEROSTOMY

BY ALBERT HYNSON CARROLL, M D.

OF BALTIMORE, MD

ASSOCIATE IN GASTRO-ENTEROLOGY IN THE UNIVERSITY HOSPITAL

A CASE of recent date that has been under my care was so overflowing with interesting findings pertaining to the rôle of gastro-enterostomy in the treatment of ulcers of the stomach that I have been stimulated to present a few thoughts on the subject

The case referred to was one of gastric ulcer, upon which a gastro-enterostomy had been supposedly done in a clinic in another city The case was referred to me by Dr Carroll, whose clinical findings are as follows

This patient, M J, is a colored woman, unmarried, aged twenty-six She has been operated upon three times, first, six months previous to coming to my service at the University Hospital Upon inquiry it was learned from the former surgeon that he had operated for gastric ulcer He stated that he had done a gastro-enterostomy The second operation was exploratory in character This was performed after she entered the University Hospital, June 20, 1913 The object and aim of this second operation was to find out what the condition was and to correct it if possible The third and last operation, which was the corrective operation, was done at St Joseph's Hospital on December 23, 1913

The present trouble began about three years ago, previous to which time she had been an exceptionally well woman She stated that before the first operation she had much pain in the

* Read before the Medical and Chirurgical Faculty of Maryland, April 29, 1914.

the gastropexy is performed Usually the appendix has been removed at the same operation

It would further seem to me, judging by the results attained in these cases, although only a small number, that in properly selected cases of gastroptosis of the water-trap type, operation is justifiable if non-surgical treatment fails to effect a cure, and that marked improvement may result from a gastropexy and careful after-treatment It is not to be expected that good results will follow if marked atony and dilatation of the stomach, or pyloroptosis rather than gastroptosis of the type described are present, and cases of this kind should be discriminated against in advising operation Also, it is obvious, if a pylorospasm, hyperacidity, reflex gastric disturbance from a chronically inflamed appendix or small gastric or duodenal ulcer is the cause of symptoms occurring simultaneously with a moderate degree of gastroptosis, that treatment directed to the relief of the gastroptosis will fail to relieve the symptoms as long as one of the other conditions may be present

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The pylorus was found patent, with no evidence of any stenosis at that point. Search for the site of the gastro-enterostomy was attended with great difficulty on account of the extensive adhesions in and about the upper abdomen.

After getting this chaos cleared up, I found an anastomosis on the posterior wall of the stomach, but instead of its being between the posterior wall of the stomach and the first portion of the jejunum, it was between the posterior wall of the stomach and the last portion of the ileum, about 20 to 24 inches from the ileocaecal valve. There was so much difficulty in finding the anastomosis and getting down to the seat of the new stoma and straightening out the adhesions, that I did not dare prolong the operation further, for fear of shocking the patient beyond repair. So I left this anastomosis as it was and simply removed the appendix, which was in marked need of removal, and closed her up with the definite understanding that she should be told of the condition and later some effort at repair be made.

The true status of the case was that since the pylorus was patent, the food contents of the stomach found their way out through this natural outlet. The small intestines were able to carry on their physiological function, in spite of this patent side-tracking stoma. Thus nourishment was kept up. This case beautifully exemplifies, or rather, corrects, erroneous ideas that some may entertain as to the movement of gastric contents after gastro-enterostomy.

The patient was told to report at regular intervals after discharge, and this she did. Although not entirely relieved, she was moderately comfortable for some weeks. At times the symptoms of vomiting and nausea were as severe as formerly. Five months after the exploratory operation, in November, 1913, she returned for readmission. At this time she was suffering almost constantly, and had lost much weight. No beds being available, she was sent to me at St. Joseph's Hospital. Again medical treatment was instituted, but with little improvement. She was sent to the operating room on December 23.

Second Operation (December 23, 1913) —I operated for the purpose of disconnecting this anastomosis between the ileum and stomach. After freeing the adhesions in the upper abdomen and getting the coils of small intestines unravelled, the anastomosis was dissected loose, and the operative procedure employed was the same as that which I make use of in doing a pylorectomy. That is, the peritoneal and muscular coats of the stomach were dissected back to the submucosa, which was clamped, ligated, severed by thermocautery, and then invaginated with purse-string sutures. The same procedure was made use of in closing

abdomen and in the epigastrium an hour or an hour and a half after eating, that she had vomited blood, that food relieved these pains for a short period, and that she had become constipated also about this time. These acute symptoms had followed a period of a year of what she called "bad indigestion". She states that for a short time after this operation she was relieved of most of these pains, but that later more severe pains, obstinate constipation, vomiting, and a sense of great pressure in the epigastrium became almost constant.

It is of interest to note that she said that, "once the bowels were freely opened, undigested food was passed for a time, within a few hours after its ingestion". This was later found to be true. Because of these increasing troubles, she came for treatment to the University Hospital on June 20, 1913, where I first saw her. The examination by the gastro-enterologist revealed an intense mucous achylia gastrica. There was no blood found in the gastric content, and a specimen of duodenal content, aspirated with the Einhorn tube, contained bile, but no blood. A "fasting stomach test meal" of rice demonstrated a retention of some of the meal for a period of 12 hours. Several stool examinations were negative to blood, but at times practically an entire meal of almost unchanged food residue was found three to five hours after ingestion, following "high enema".

On palpation of the abdomen there was tenderness in the umbilical region, even on slight pressure, and dull pain in the region of the cæcum and ascending colon. There was distention. No tumor mass could be made out. The entire lower abdomen was rather tympanitic and splashing sounds were heard at various times in the ascending colon and in the stomach. Much difficulty was experienced in securing the earlier series of X-ray pictures, first because of the vomiting of the patient, second, because of the thickness of the abdomen, and on account of not having at our disposal a strong enough apparatus to penetrate it. These plates definitely, though faintly, demonstrated that some bismuth was leaving the gastric bag, not only by the stoma, but also by the pylorus. Since this dual exit was known, and also because of the persistent vomiting and pains, plus a 12-hour retention, notwithstanding the usual treatment, consisting of lavage, liquid diet and HCl, it was deemed best to open the abdomen, not with the expectation of finding an ulcer, but because partial occlusion was suspected, not only of the stoma, but of the pylorus.

Operation (June 20, 1913) — The operation was a distinctly exploratory one. The appendix was found to be very ugly and chronically inflamed, but this was absolutely incidental. The intraperitoneal conditions were very chaotic, with many adhesions

Fig 2 —Opening in ileum closed and a lateral anastomosis done, pylorus left patent, stoma closed

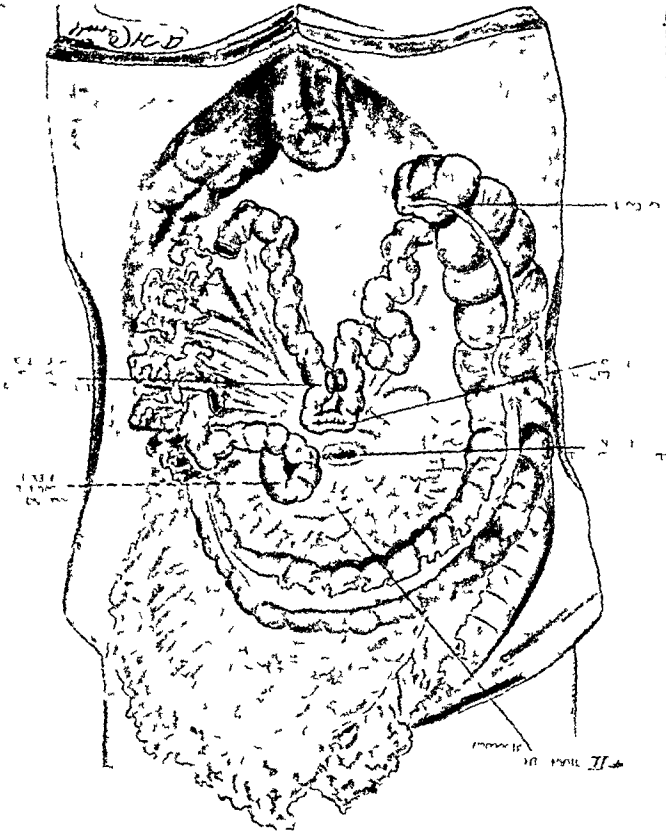
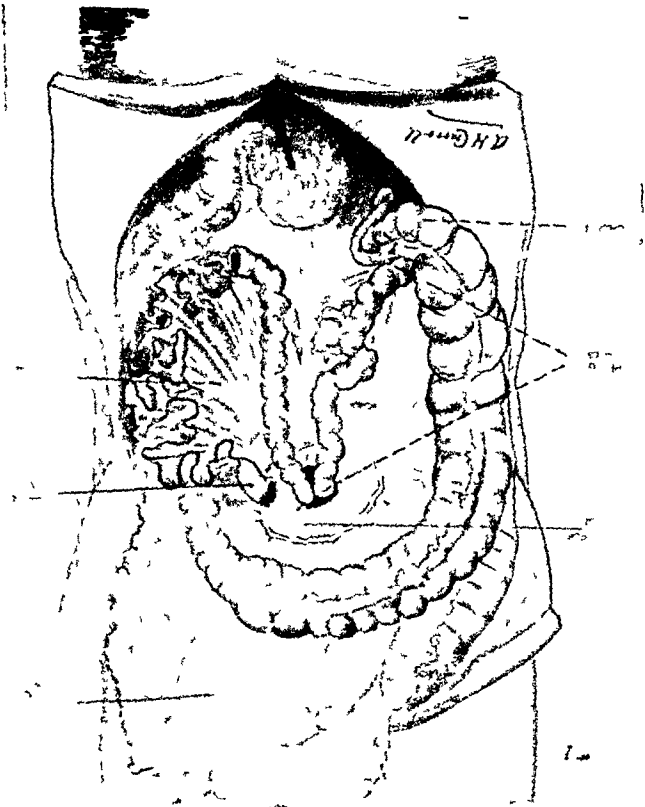


Fig 1 —Ileum fourteen to sixteen inches from caecum anastomosed to stomach, posterior gastro-enterostomy



the ileum after the anastomosis was disconnected I found that in invaginating the lateral opening into the lumen of the ileum it diminished its lumen to such an extent that I was afraid it would be impinged upon, and not be sufficiently large for the passage of the food residue. Rather than trust to it absolutely, I concluded to do an entero-enterostomy, or a lateral anastomosis, in this loop of the ileum immediately adjacent to where the anastomosis was done. This was done by the use of a Murphy button in order to save time. The abdomen was closed and uninterrupted recovery ensued (diagrammatic drawings, Figs 1 and 2). The Murphy button was passed on the thirteenth day after the operation. She was discharged apparently in excellent health on January 21, 1914.

Later Observations—The patient reports about twice a month. She is able to cook and do the laundry work for a family of four. She is obstinately constipated, but as a whole considers herself to be well off. At no time since she first came under observation have there been any of the classic symptoms of gastric or duodenal ulcer, either before the gastro-ileostomy was undone or since that time. Figs 1 and 2 demonstrate the conditions before and after the gastro-ileostomy was undone and the pylorus allowed to functionate normally.

The findings and the facts noted in the above case bring up many interesting points. And among these, apart from the unusual and unheard-of point of anastomosis, the one of the most interest to me was the beautiful demonstration that I was able to give at my first operation of the stomach peristalsis. In spite of its dual openings, definite peristaltic waves continued, conducting the gastric contents to the pylorus regularly and rhythmically, notwithstanding the fact that the new stoma was still patent and sufficiently large for gastric contents to go that way. But I say, in spite of this, the definite waves of muscle contractions rhythmically progressed to the normal aperture, namely, the pylorus.

Furthermore, examination of the pylorus revealed no evidence of antral, pyloric or duodenal ulcer then present, or any indications of having been present. These facts, I think, definitely answer the question which immediately arises. If this patient's entire small intestinal tract was side-tracked off by this operation, namely, by an anastomosis being made between the posterior wall of her stomach and the last portion of her ileum, as was the case, in what way did she get nourishment sufficient to carry on life? As I have said, this question is answered by the demonstration that in spite of the new stoma, the bulk of the food

GASTRO-ENTEROSTOMY IN ULCERS

contents from the stomach must have gone on through the pylorus and down on through the small intestines, and in that way nourishment was obtained for the maintenance of life

Now to come back to the subject, what is the rôle gastro-enterostomy plays? It has been largely conceded that many stomach and duodenal ulcers are finally considered grave enough to be classed as surgical, although the treatment offers at best a vexed and perplexing problem to both physician and surgeon. Still, what has been done with them by the surgeon in the past, has been resorted to on account of the supposedly favorable influence exerted upon these ulcers of the stomach, situated in the antrum, or at the pylorus, or in the duodenum. It has been the operation of choice, because by adopting this procedure it was thought a condition was established favorable to the healing of the ulcer. However, it has likewise been conceded that this operative procedure has had no effect upon ulcers in other localities of the organ (namely, on the lesser curvature, in the fundus, or elsewhere)

But have these favorable results following gastro-enterostomy been of lasting nature? I believe statistics show that they have not been lasting, but that, on the other hand, recurrence or recrudescence of the ulcers in and about the pylorus and the first part of the duodenum has taken place in at least 45 per cent of the cases, and that quite a large percentage of them have later become malignant

This, although a melancholy truth, nevertheless appears to be a fact, and therefore one naturally asks, is there no better, or more lasting, operative intervention for these very important and common conditions, which are so very far-reaching in their consequences and with such a varied array of complications, all of which are so serious in character, such as disabling contractions, obstructions, hemorrhage, perforation and malignant degeneration. Each and any one of these is of such importance as to command a chapter to itself, and thorough study for correction

Acute perforation of gastric or duodenal ulcer is alone, by all odds, the most serious, and I might say, the most tragic disaster that can happen in the human body. No accident in surgery is more perilous nor so rarely recognized early. Does it seem reasonable then, that an operation such as gastro-enterostomy, with its easily demonstrated unscientific principles, would possibly meet and correct these serious consequences arising from stomach ulcer? And yet this has been for years the "cure-all" for almost every stomach malady that exists

Let us discuss for a moment some of the known factors of interest

We do know, however, that gastro-enterostomy (and we must understand by that the creation of a new opening between the anterior or the posterior wall of the stomach and the first portion of the jejunum) exercises an influence on antral, pyloric or duodenal ulcers, namely, those situated in the grinding portion of the stomach and the first portion of the duodenum, in practically only two ways first, either by diverting or side-tracking the contents of the stomach away from the pyloric orifice into the jejunum, or second, by permitting a reflux into the stomach of the alkaline contents of the jejunum, which neutralizes the acid gastric contents. One of these means alone or both together favorably affects ulceration in these particular areas, and supposedly aids in the healing of same, but definitely has no effect upon ulcers located in other portions of the stomach, lesser curvature, fundus, or elsewhere.

Furthermore, it is pretty definitely understood that when an ulcer is situated in the pyloric region of the stomach, or first portion of the duodenum, there is accompanying it, or in consequence of it, a spastic contraction of the pyloric muscle, which is more or less constant, and in a measure partially, and in some cases completely, occludes this orifice. And in accordance with this belief it is further known that ulcers situated in other sections of the stomach have no such influence on the pylorus. Therefore, when we have this partial pyloric stenosis due to spastic contraction, in consequence of the ulcer, then the influence gastro-enterostomy has is a favorable one, and is exactly the same, and as favorable, as the effect obtained in those earlier cases of gastro-enterostomies performed for starvation, in consequence of the pylorus being organically closed by stricture or tumor.

As we all know, in these cases the results are marked and brilliant. The gastric contents no longer pass through the pyloric orifice but through the new stoma, and thus the irritation from the food, exerting a harmful effect on the ulcerated area, is done away with, because the irritating agent is diverted through the stoma. After healing of the ulcer takes place, if it does, the spasm of the sphincter muscle ceases, and the food contents of the stomach revert back to the pylorus, this now being patent for its exit, and no longer passes out through the stoma. These are surgical facts—what, then, is the consequence?

There is a prevailing opinion among the many medical and some surgical men that the stomach is a passive reservoir during digestion, and that when a new opening is created at the most dependent point of the organ, gravity alone will cause the gastric contents to pass through this new opening into the small intestines. Therefore, a gastro-enteros-

concerning the influence gastro-enterostomy has upon gastric and duodenal ulcers, and in that way try to modify the operative procedure, in order that it may be more lasting in its effects, as applied to the cure of these ulcers

Since we do not know the etiology or exact pathogenesis, any more than we know the exact cause of cancer of the stomach, we know that with the one, which we regard as the precancerous condition of cancer of the stomach, so likewise with the other, that chronic and constant irritation is recognized as an important elemental factor in the etiology. Recently, however, many experimental workers have advanced the theory that gastric and duodenal ulcers are due to infective states of the stomach and duodenum. That given a minute or gross defect in the gastric mucosa, produced by trauma or what not, such minute or gross defects will grow into ulcerations, provided the stomach contains pathogenic bacteria.

Barclay's views and conclusions regarding the etiology are worth while, and I herewith quote the following: "Septic conditions in the mouth or other sources of swallowed septic matter, constipation, mucous colitis and a variety of other conditions are capable of producing spasmodic contractions of various parts of the stomach. The spasm produces a narrowing of the lumen that is of great functional importance, causing a definite obstruction to the passage of food. By an indiscretion of diet or want of mastication, something too large to pass easily through the channel has to be forced through by powerful peristalsis. This leads to an abrasion at the point where the lumen is narrowed and where there is the constant irritation of food passing over it. A surface is exposed that is not structurally fitted to withstand the action of the gastric juice. In this way an ulcer is formed which in its turn perpetuates the original spasm that determined the site of the ulcer. A vicious circle is established, the ulcer now being actually the cause of spasm that prevents healing, so that even if the original cause of the spasm is removed, there is little, if any, improvement in the local condition."

It seems to me that one must be fully conscious of the importance of this spasmodic element as a complication of organic lesions in this region of the stomach, and this undoubtedly is the most important keynote of the whole argument. Whether the spasm at the pylorus is the effect of the ulcer or, on the other hand, the cause of the ulcer, is a very difficult question to decide. To repeat, since we do not know their exact causation, it is difficult to state definitely just how our therapeutic agents exercise a healing influence on them.

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the jejunum This, it seems to me, is the main factor in determining the influence that gastro-enterostomy exerts on gastric ulcers By the spasm at the pylorus the gastric contents are diverted away from the ulcerated area But, as Cannon wisely states, "We should not deceive ourselves by the supposition that the operation permits this region to enjoy entire relief from the peristalsis and the undue muscular activity in consequence of it, or the marked hyperacidity which is present in many of these cases" Relief and help does come in this way, and also by the reflux of the alkaline juices from the jejunum; this is conceded to be a fact, and, furthermore, is clinically noted shortly following the operation of gastro-enterostomy

After healing takes place, the spasm of the pyloric sphincter muscle relaxes The pylorus again becomes patent, and the stomach contents no longer freely pass through the new anastomotic orifice, but revert back to the patent pylorus But we must always remember that the etiological factors may remain. Is it, then, any wonder that there is such a high percentage of recurrences? At least one of the accepted original causes of the ulcer returns The trauma that exerted itself at the pyloric orifice again takes place, the stoma frequently has closed in a measure, and then, even when it could again be of service, it ceases to afford an exit for the stomach contents The old ulcerated area is very likely to start into activity again These two factors, namely, the new stoma and the neutralizing effect of the gastric content, do not stay the muscle contractility, and therefore do not put it completely at rest, which is so important a factor in healing I believe the neutralizing effect is not sufficient in itself to be of marked utility Therefore, we may conclude that gastro-enterostomy can accomplish good only in such ulcers as are situated near the pylorus, an area which constitutes four-fifths of the ulcer-bearing surface of the stomach

Barclay and Cannon along with Hertz, whom both quote, have given a deeper insight into the mechanics of digestion than most of the others put together Naturally, the surgeon, in dealing with the pathological conditions which he encounters, must base his efforts upon the primary physiological and mechanical facts which have been established.

To sum up, from the surgical point of view, I would say First, that gastro-enterostomy is of value only in pyloric and duodenal ulcers attended with pyloric spasm, and is not always of lasting effect Second it can be of no value in ulcerations situated in other parts of the organ, although the symptom of hyperacidity is markedly relieved in many of the cases by it Third, when the pylorus becomes patent, the artificial stoma tends to contract and close, and there is

tomy has been regarded by them as a drainage operation, and the idea arose in the past that it was of paramount importance that the stoma must be placed at the lowest point of the stomach, in order to insure good drainage. In order to further aid in the accomplishment of this purpose, patients have been placed in the upright posture following operation, the operator stating that the gastric contents would more speedily gravitate through this dependent opening.

Those who have leaned closely to this idea have been unmindful of the fact of the true muscular contracting force of the stomach, which forces food contents rhythmically toward the pylorus, and that its normal physiological propelling power is directed always, as it should be, toward its own natural exit, namely, the pylorus. The drainage opening so called, or stoma, will not drain continuously or with certainty, so long as the pylorus is patent. This is clearly and graphically demonstrated by the findings in the above case, and from a study of the accompanying X-ray series presented later.

Cannon ingeniously offers valuable conclusions on this subject in his book on the "Mechanical Factors of Digestion," and clearly points out that the stomach is not at any time during digestion in the condition of a passive reservoir. He states "The cardiac end is exerting a positive pressure, and so long as food is present the pyloric end is the seat of continuous peristalsis, and if the pylorus is patent, these waves of peristalsis direct the food contents to this natural opening, even though there be a stoma, and gastro-enterostomy being a drainage operation is, therefore, out of the question." It has been experimentally proven that the hydrostatic conditions in the abdominal cavity are such that gravity drainage from the stomach is impossible. As a proof of this last statement, it has been experimentally shown that "when a gastro-anastomosed stomach is filled with water, the latter does not run out of itself, even though the animal is in an upright position, and, as has been clearly pointed out by Kelling, Cannon and others, it is an important fact to bear in mind that material never moves along any part of the alimentary canal unless the pressure is greater on one side of it than on the other. Furthermore, it has been shown that the chyme always takes its normal course through the pylorus, if the latter is patent, rather than through any artificial opening."

The conclusions, therefore, may be justly drawn that if the pylorus is patent, the gastric contents are forced out through this natural opening, even though portions at times also pass through the anastomosis. It is only when the pylorus is definitely closed that the entire contents of the stomach pass through the anastomotic opening into

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the patient from this oncoming possibility of malignant degeneration. Therefore, as gastro-enterostomy alone cannot meet the requirements, in that it does not combat the tendency to malignant degeneration, it should play but a partial rôle in the treatment of gastric ulcers.

There is one condition in which gastro-enterostomy may still be considered the operation of choice in those cases of benign stenosis where the lumen of the pylorus has been almost entirely occluded and is permanent in character. These cases seek relief from starvation, and are markedly helped by gastro-enterostomy.

Finally, pylorectomy meeting the various requirements, protecting against recurrence of the ulcer, eliminating the possibilities of complications, and removing definitely that chief source of carcinoma, seems to me to merit more definite recognition.

ACTIVITY OF THE PYLORUS FOLLOWING GASTRO-ENTEROSTOMY

In accordance with Dr. Martin's suggestion that there be gathered photographs of some cases upon which gastro-enterostomies and pylorotomies plus gastro-enterostomies, have been done, twenty cases have been reviewed, in which the patient has been serially photographed following gastro-enterostomy. In two of the cases the pylorus had been excised.

In none of these cases was the pyloric outlet found to be obstructed by scar tissue formation or from adhesions, at operation. In all of them the ulcer was in the "ulcer bearing area," and in all the symptoms had disappeared. Any case which exhibited symptoms would not have demonstrated the normal post-operative functioning of the pylorus and stoma.

The point of greatest interest is whether the pylorus is relieved of its duties once the new opening has been established. It appears from a study of these cases, personally at least, that there is really clear and incontestable evidence that the major portion of the work of emptying the stomach is performed by the pyloric gateway, if this is unobstructed and patent.

In the normal subject, it is not easy to see the bismuth which has passed through the pylorus and on into the loop of the duodenum, and this is due to the very small quantities allowed to pass at a time. It passes in very finely divided masses, and casts such a faint shadow that in order to "get" this in the X-ray plate, a very rapid tube must be used.

That portion of the bismuth meal which passes through the stoma

present a tendency for the reformation of the ulcer Fourth, is it not worth while, under these circumstances to adopt a means which may be of more lasting effect and unattended by this high percentage of recurrence?

The high percentage of recurrences, the serious and ever-present complications, and the tendency to malignant degeneration, which is far more common than hitherto suspected, warrant, in my judgment, a more radical and efficient method than is offered by gastro-enterostomy alone Gastro-enterostomy does not offer permanent relief in preventing these complications

Statistics show that in 70 per cent of the cases of cancer of the stomach there is a precancerous history of ulcer These facts alone seem to me to warrant excision of the ulcer-bearing area, and in all cases the operation of pylorectomy offers a greater promise of success than any other operative procedure that we have at our command The consensus of opinion to-day is that the ulcer-bearing area should be removed, and it is best removed by pylorectomy But the criticisms causing it not to be in wide-spread favor are that it is attended with too high a mortality This mortality is given as from 12 to 15 per cent, whereas the mortality attending gastro-enterostomy is given as $1\frac{1}{2}$ to 2 per cent I feel that this is an unfair criticism of the procedure, and it appears to me that the mortality that is given is out of all proportion and entirely too high I further believe that the operation of pylorectomy should be done in such a way as to have the mortality no greater than that attending gastro-enterostomy

In my own service the mortality attending pylorectomy has been less than the mortality attending gastro-enterostomy The few cases that I have recently done for ulcers (five in all) have been unattended with mortality, and the surgical recovery was unattended by any serious disturbance The greatest proof of the wisdom of this operative procedure in these few recent cases has been that in three out of the five the report from the microscopic findings was that of "beginning malignancy" This, I think, speaks more forcibly for the operative procedure than anything I know of

The operations of pyloric occlusion which have been suggested by numerous operators are inefficient and unscientific, and in no way are to be rationally considered Such an occlusion as devised by von Eiselsberg, namely, by completely dividing the stomach from the duodenum and suturing the two ends, seems to me to offer nothing that is to be commended The mortality would probably be quite as high as in a definite pylorectomy, and, furthermore, it offers no protection to



FIG 3—Series No 1 Case 4090 Gastro-enterostomy plus pylorotomy Twenty minutes after a small bismuth meal—the bismuth is leaving freely by the stoma The jejunum is filling rapidly There is no evidence of a dragging at the site of the stoma, as in many instances where gastro-enterostomy alone has been done The outline of the stomach is regular and normal in shape and position with the exception of the 'filling defect' at the pyloric end where the invagination of the prepyloric portion was done in closing the opening after pylorotomy



FIG 4—Series No 1 Case 4090 Taken one hour after Fig 3 The stomach is nearly empty Bismuth mass is concentrated in the caecum (The first plate in this series was similar to this, but the story so graphically as Fig 4)

is not finely divided and at first is composed of comparatively large masses. This is exactly what one would anticipate and to which attention has been previously called, but unless this is borne in mind it will appear to the casual observer in viewing a series of plates taken following gastro-enterostomy, that all the bismuth is leaving by the stoma.

In the "immediate plate," bismuth is seldom seen in the duodenal loop in normal cases. Time must elapse before the reflex activities, which control the opening and closing of the pyloric sphincter, allow any bismuth to pass. But exactly the opposite is true of the stoma or new hole which has been made in the wall of the stomach. This hole is opened at once when a distending meal is introduced, since there is a stretching of the wall, and normal tonicity has not had time to become established. The result is that there is always a distinct shadow seen in the immediate plate extending into the intestine through the stoma.

However, in the study of this series, bismuth was seen in the loop of the duodenum in the *later plates* in every case, while evidence of the rapid exit through the stoma is lacking, although at times even in the later plates the stoma does afford a generous outlet.

Barclay and many others have called attention to this, and some think that later the stoma becomes endowed with a certain control over the exit of the gastric contents. I have not observed this. It appears more reasonable to suppose that later the major portion of the work is done by the pylorus, and that only occasionally is there a rush of contents through the stoma, during the intervals, perhaps, between vigorous peristaltic waves, and when the pylorus is not physiologically ready to open.

The question is not merely an academic one, if we consider irritation and trauma as etiological factors in ulcer. If the X-ray plates shown serve to demonstrate graphically in man, that the pylorus will continue to functionate, notwithstanding the presence of the stoma following gastro-enterostomy for ulcer, the operation of pylorotomy may appear to some, who have not decided the question fully for themselves, to have a greater value as a procedure in the surgical treatment of ulcer at or near the pylorus.¹

Series No 1—These plates are of a case in which a pylorotomy was done. It is interesting to note the normal position of the stomach, in contrast to the

¹ The passage of bismuth through the pylorus, although clearly demonstrated in an X-ray plate, in reproduction first in the printed photograph and later in the engraving, loses much in detail, so small is the amount and faint the shadow in normal cases. Retouching or strengthening the print would render it of negative value.



Fig. 7—Series No. 2 Case 4027 A spasm has shut off the progress through the duodenum temporarily

FIG 5

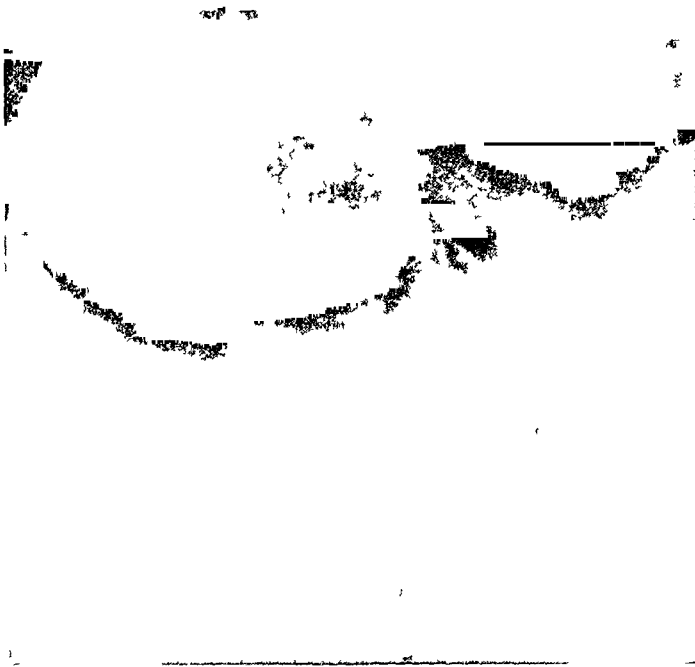
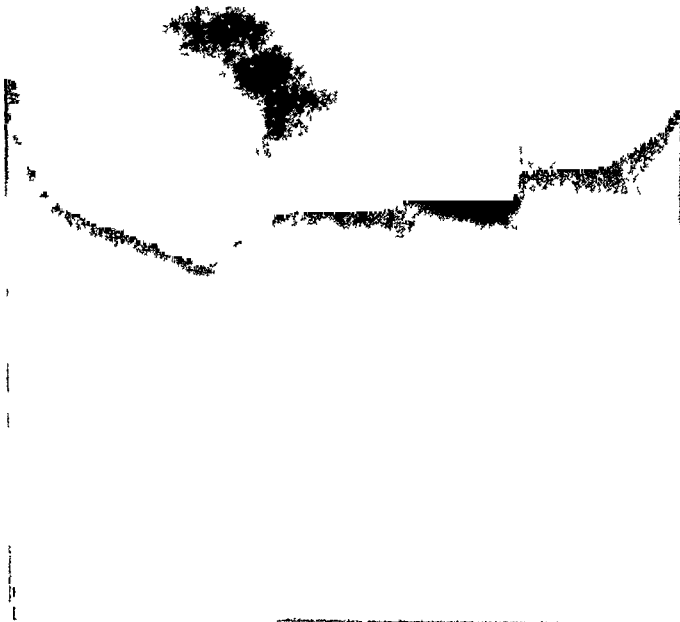


FIG 6



FIGS 5 and 6—Series No. 2. Case 4027. Gastro enterostomy. Operation five years ago for duodenal ulcer(?) new ulcer. These plates were taken without a previous bismuth meal and at short intervals. Notice the rapid filling of the jejunum in both plates. The pyloric end of the stomach appears drawn to the right by perigastric adhesions. The first bismuth liberated from the stomach through the stoma (Fig 5) passes on rapidly and is seen in the pelvis in Fig 6 while in this plate the distended prepyloric portion and the completely relaxed sphincter allow a rapid evacuation of bismuth into the duodenum.

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distortion, particularly of the pyloric end of the stomach, in many of the cases in which gastro-enterostomy alone has been done. There is no evidence of a dragging at the site of the stoma. The outline is unusually symmetrical and normal, with the exception of the filling defect caused by the invagination of the prepyloric portion, following the operation. The bismuth meal is seen to be leaving in an even manner and well distributed along the small intestine. The second plate (Fig 4) taken one hour later, shows the stomach nearly half empty, and the bismuth well on its way to the cæcum (case No 4049).

In series No 2, in which a gastro-enterostomy alone has been done, it will be noticed in the first plate (Fig 5), taken immediately after a bismuth meal, without a "previous meal," that there has been a rush of content into the intestine through the stoma, while the gastric peristalsis has carried the bismuth beyond the prepyloric region, and has formed a well defined "bishop's cap." Nothing has as yet entered the duodenum *via* the pylorus, nor has there been any backing up, against the normal peristaltic duodenal waves of contraction, of material which might have entered the tube through the stoma. In the second plate (Fig 6), however, the first gush of bismuth laden meal has dissipated itself along the small intestine, while the duodenum is seen to be laden with bismuth which has entered through the pylorus. The prepyloric portion is greatly distended with material which gastric peristalsis has brought there and which is ready to rush into the duodenum when the pylorus opens during the systole of the next gastric cycle. In the third plate (Fig 7) of series No 2, the gastric content appears to be quietly making its exit through the pylorus, and none is seen to be passing onward through the stoma. The gastric wall is pulled over towards the pyloric end, at the site of the stoma. This is not unusual and is no doubt the cause of a kink or angulation in the duodenojejunal region which partially obstructs the lumen of the tube, and results at times in the backing up into the stomach of duodenal secretions, with vicious circle and vomiting.

Lewis Gregory Cole, whose cinematograph pictures of the bismuth-laden stomach and intestines have demonstrated so graphically the normal and pathological functioning of these organs, has recently told me definitely that his studies have demonstrated the persistence of pyloric functioning. The facts shown by these roentgenological studies appear sufficiently definite to permit again calling attention to a phenomenon readily accepted by many, but persistently disregarded and even unknown to a large number of physicians and surgeons.

CONCLUSIONS—It can be shown radiographically that in man, as well as experimentally in animals, a patent pylorus tends to functionate notwithstanding the presence of a patent stoma. That gastric contents will leave *via* the stoma, and at first in large quantity, but that it is not a fact that the egress continues rapidly later.

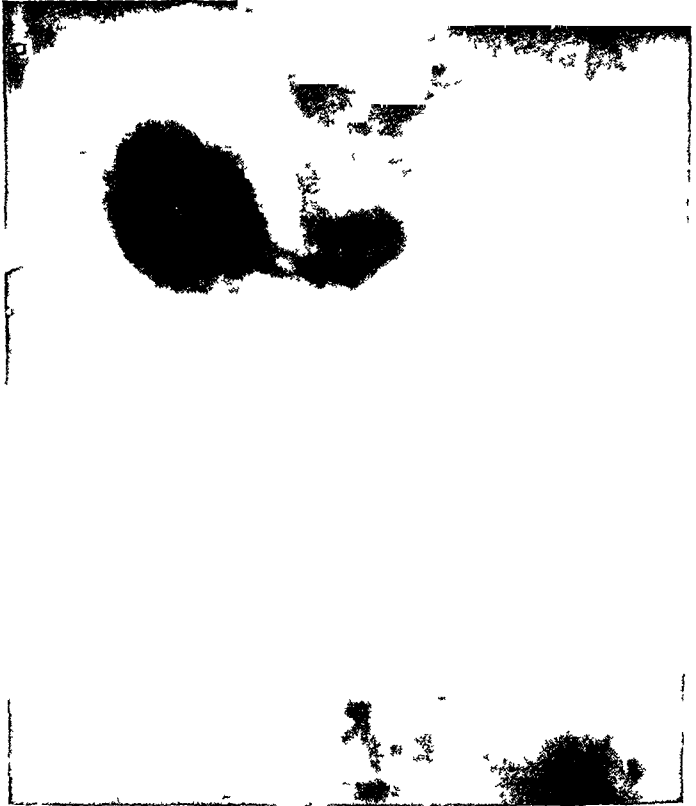


FIG 8 --Series No 2 Case 4027 The hour-glass condition due to the operation persists

PATHOGENESIS OF UMBILICAL HERNIA

remember is, that it is only one, and a continuous layer. For the sake of simplicity it will be called "transversalis" fascia.

3 That all the vessels which escape from or run into the abdomen lie between the peritoneum and the transversalis fascia.

4 The last statement being true, it also follows that before a vessel can escape from or enter the abdomen, there must be an opening in the transversalis fascia, *e g*, the internal inguinal ring, or internal femoral ring.

5. These openings in the transversalis fascia are not bounded by an abruptly terminating sharp edge. At the point of exit of the vessel, the transversalis fascia becomes everted, and is prolonged on to the vessel in the form of an adventitious covering, finally blending with the wall of the vessel itself. This is excellently demonstrated in the so-called infundibuliform fascia, and sheath of the femoral vessels.

6 These openings in the transversalis fascia are places of lesser resistance in the abdominal wall, and in consequence are the only locations through which hernial protrusions occur.

7. The aforementioned prolongations of the transversalis fascia form one of the coverings of the hernia.

These seven anatomic principles have, I believe, been abundantly proven in my previous publications upon the subject. It remains merely to be shown how far they apply to umbilical hernia.

Before proceeding, however, with this discussion, it is essential to first describe the development and anatomy of the normal umbilicus. In many respects the development and anatomy of the umbilicus, while apparently very simple, is in reality far more complicated than, for instance, that of inguinal hernia, owing to the number of structures which pass through it during fetal life.

It is unnecessary for our purpose to discuss the earliest development of the embryonic membranes, we shall begin at the period when the umbilical cord and urachus are already formed. The urachus passes from the inferior margin of the umbilical ring perpendicularly downward to the vertex of the bladder. The two umbilical arteries also pass downward, but slightly diverging from each other, to the lateral aspects of the bladder. The single umbilical vein passes from the upper part of the umbilical ring backward and upward, and slightly also to the right, into the round ligament of the liver.

At birth there is usually an extension, for a short distance, of the skin epithelium over the umbilical cord, the cutaneous margin diminishing in an irregular wavy line. Directly after birth the stump of the umbilical cord, which had been ligated one or two inches distally from

THE PATHOGENESIS OF UMBILICAL HERNIA

BY ALEXIS V. MOSCHCOWITZ, M D
OF NEW YORK

PROFESSOR OF CLINICAL SURGERY, COLUMBIA UNIVERSITY, ATTENDING SURGEON, MT SINAI HOSPITAL,
VISITING SURGEON HEB MORIAH HOSPITAL

Introduction —The impulse for this study arose from an invariable phenomenon observed in umbilical herniæ, namely, that despite a fairly large hernial protrusion, an umbilical depression is still present

In numerous articles the writer has repeatedly called attention to the importance of the transversalis fascia and blood-vessels in the pathogenesis of inguinal and femoral herniæ. As I shall demonstrate, the same factors hold true in the pathogenesis of umbilical hernia

Pathogenesis —It is customary to divide umbilical herniæ into three different groups (1) Herniæ into the umbilical cord, (2) umbilical herniæ of children, and (3) umbilical herniæ of adults. A hernia into the umbilical cord is, however, a congenital malformation, and in no sense of the word a hernia, there is no valid reason, therefore, why this malformation should be included in a discussion of umbilical hernia. On the other hand, umbilical herniæ of children and of adults are identical, both on theoretical and practical grounds. They are certainly the same both from an anatomic and pathologic view-point. It is true that an umbilical hernia in children is more amenable to non-operative treatment than the adult variety, but this is hardly a sufficient basis upon which to make a special classification. Furthermore it is more than probable, in spite of assertions to the contrary, that an umbilical hernia in an adult had its origin in early infancy.

In order to more readily understand the development of an umbilical hernia, it is necessary to again recall certain general facts of fundamental importance in the pathogenesis of every hernia. These are the following

1 That, with certain exceptions, namely where the viscera or their mesenteries find their attachment, the abdominal parietes are lined throughout by peritoneum

2 That externally to the peritoneum, and separated from it merely by the more or less developed properitoneal fat, there is everywhere a continuous layer of a strong fascia. This fascia has received different names in different parts of the abdomen, depending upon the particular anatomical location, but in this connection the only particular point to

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the obliterated vein and the upper margin of the umbilical ring. Upon theoretical grounds we should expect to find such a weak spot also inferior to the vein, in fact, however, we do not find such a hiatus, and for the following reasons. The umbilical ring is very small, and in this limited space there occurs a firm union between the terminations of the two umbilical arteries and the vein, which tends, on the one hand, to obliterate the weak area inferior to the vein and, on the other hand, to enlarge the opening superior to the vein still more.

In early fetal life the lumen of the bladder communicates with the urachus. Later the lumen of the urachus becomes obliterated, and is represented by a cord-like structure, even the musculature disappears, except at its vesical attachment.

Surgical Anatomy—For practical purposes the umbilicus may be regarded as a hiatus in the linea alba. Its surgical anatomy may in consequence be more readily understood if the anatomy of the linea alba in its immediate neighborhood is studied.

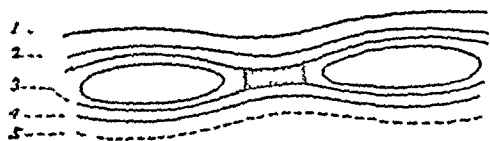


Fig 1

FIG 1 —Diagrammatic cross-section of linea alba. 1, skin, 2, superficial fascia, 3, sheath of rectus, 4, transversalis fascia, 5, peritoneum.

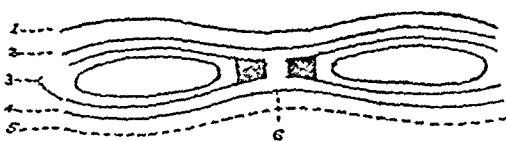


Fig 2

FIG 2 —Diagrammatic cross-section of umbilicus in its simplest form. 1, skin, 2, superficial fascia, 3, sheath of rectus, 4, transversalis fascia, 5, peritoneum; 6, umbilical opening.

The linea alba is a fibro-aponeurotic structure placed in the midline of the abdomen, and is formed by the coalescence and interlacing of the sheaths of the recti on either side. It is of some importance to remember, that neither the superficial fascia, nor the transversalis fascia, nor the peritoneum enter into the formation of the linea alba, all these structures passing freely from one side of the abdomen to the other. A purely diagrammatic cross-section of this region would therefore have the appearance as shown in Fig 1.

It has frequently been mentioned that the umbilicus may be regarded as a hiatus or defect in the linea alba; reduced to its simplest form the umbilicus may therefore be represented as in Fig 2.

At the location of this defect in the linea alba all the structures in the vicinity undergo a certain amount of alteration.

1. The skin is not continuous, as it is represented to be in the preceding diagram (Fig 2) because at the centre of the umbilicus the skin is replaced by cicatricial tissue, caused by the healing of the umbilical ulcer.

its abdominal insertion, begins to necrose, and is usually cast off within five to seven days, leaving behind a small granulating surface, or what may be termed at this stage the "umbilical ulcer." This umbilical ulcer is slightly elevated above the surrounding integument. In the subsequent course healing of the shallow ulcer takes place, by the epithelium from the surrounding skin margins growing over it, and when healing is completed, the umbilicus is a slightly depressed cicatrix. Coincident with these changes other more important and more complicated changes have taken place in the depth. The three vessels which enter into the formation of the umbilical cord become thrombosed after ligation, this thrombosis, moreover, extends up to the first collateral branch, as usually occurs in the surgical ligation of any vessel. The two umbilical arteries thus become converted into the two obliterated hypogastric arteries, and finally form the two lateral superior ligaments of the bladder, while the umbilical vein enters into the formation of the round ligament of the liver.

The final change through which this ultimate end result is obtained is still a matter of doubt and controversy. According to some observers the process is merely one of thrombosis, organization of the thrombus and subsequent retraction, but Herzog (*Die Rückbildung des Nabels und der Nabegefäße*, München, 1892) in a very laborious and apparently convincing study shows that the process is not quite so simple, and is more in the nature of a degenerative process, because the muscular coat eventually disappears from the obliterated parts of the vessel.

Herzog also has shown for the first time, that coincident with this stage, or already during intra-uterine life, other changes occur, which are particularly well marked in the umbilical arteries. During fetal life the adventitia of these vessels is particularly strongly developed, and when the circulation has ceased within the lumen, this coat contracts and retracts, thereby fastening these vessels firmly to the inferior margin of the umbilical ring and against the anterior abdominal wall. The presence of such an extraordinary large amount of embryonal connective tissue fills the lower portion of the umbilicus with a firm layer of tissue, which, in conjunction with other factors to be later described, acts as an efficient barrier against the development of a hernia at this point.

The umbilical vein, however, does not possess so well-developed an adventitia, the changes just described for the umbilical arteries, therefore, do not take place, or only to a very limited degree. The result is, that there remains constantly a more or less developed hiatus between

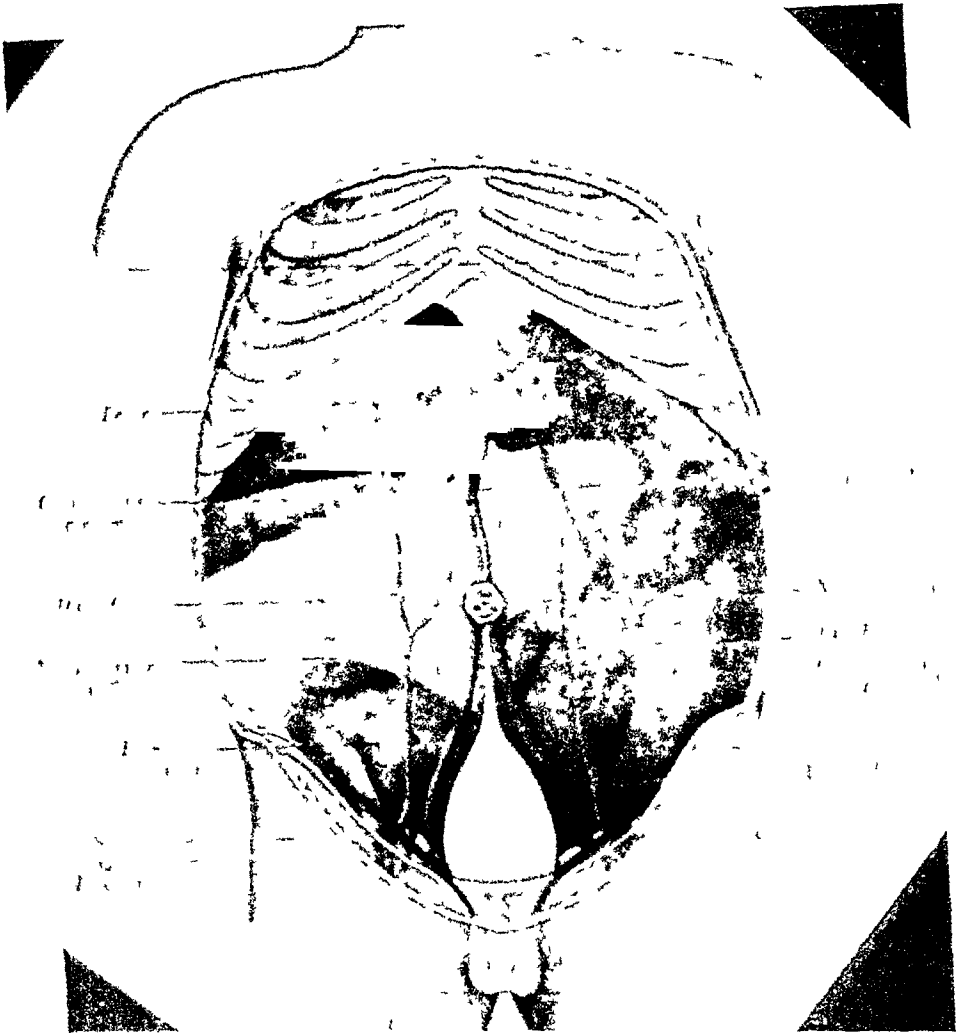


FIG 5 —Urinary bladder of a newborn (Waideyer)

For the same reason also, the subcutaneous fat ceases at the margins of the umbilical ring, so that the cutaneous cicatrix becomes adherent directly to the underlying superficial fascia. The umbilicus is frequently spoken of as the umbilical depression, but this depression is only an apparent one, because in reality the umbilicus is on a level with the structures composing the linea alba. Its apparent depression is due merely to the absence of subcutaneous fat at the umbilicus, the more this surrounding layer of subcutaneous fat is developed, the deeper the umbilicus will appear to be, and *vice versa*. At this stage of our description Fig 3 would be a correct diagrammatic representation of the umbilicus.

2 For didactic purposes the description of the anatomy of the superficial fascia will be reserved until after the deeper anatomical structures have been described.

3 The peritoneum is directly continuous from one side to the other

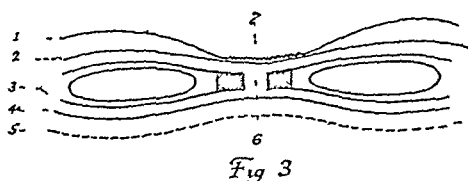


FIG 3 —Diagrammatic cross-section of umbilicus showing the umbilical cicatrix 1, skin, 2, superficial fascia, 3 sheath of rectus, 4 transversalis fascia, 5, peritoneum, 6, umbilical opening, 7, umbilical cicatrix

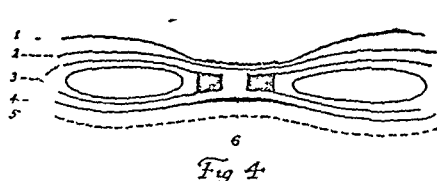


FIG 4 —Diagrammatic cross-section of umbilicus showing Richet's fascia 1, skin, 2, superficial fascia, 3 sheath of rectus, 4 transversalis fascia, 5 peritoneum, 6, Richet's fascia

At the superior margin of the umbilicus the peritoneum is reflected, in order to enter into the formation of the round and falciform ligaments of the liver. Well within the confines of the umbilical ring the peritoneum is slightly puckered up, and is also intimately adherent to the underlying transversalis fascia.

4 The transversalis fascia is fundamentally a continuous layer extending from one side of the abdomen to the other. It is a curious fact, and at the same time a wise provision of nature, that at the location of the umbilicus (an obvious place of diminished resistance) this portion of the transversalis fascia is especially strong. Attention to this point was first drawn by Richet (*Archives Generales de Médecine*, December, 1856, January, 1857) who found, in numerous dissections, that, in a large majority of the cases, this portion of the transversalis fascia is materially strengthened by transversely running, interlacing fibres. This increased strength is so pronounced that he deemed this portion of the transversalis fascia worthy of a name, and he calls it the "umbilical

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fascia." The extent of this fascia, both in a vertical and horizontal direction, varies within wide limits. Its tensile strength is so great, that were it not weakened by the passage of vessels and other fetal structures, the umbilical fascia would be ample to withstand any increase in the intra-abdominal pressure. It must again be emphasized that the umbilical fascia is not an extra layer placed here by nature, but simply a more highly developed portion of the transversalis fascia. It is rather difficult to present diagrammatically the presence of Richet's fascia, an attempt has been made in Fig. 4.

Finally, it is necessary to show the relationship of the umbilical vessels and urachus to the umbilicus and the various fascial layers of which it is composed. Because of the diversity, number, and divergence

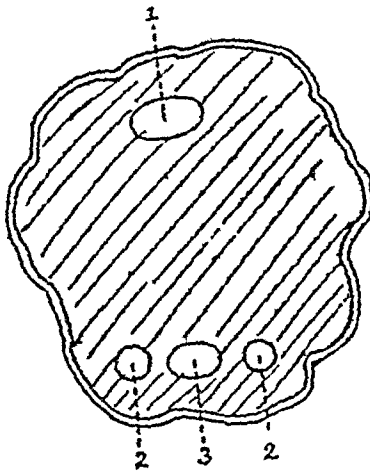


Fig 6

FIG. 6.—Diagrammatic anterior view of umbilicus. 1, umbilical vein, 2, umbilical arteries, 3, urachus.

of these structures, the problem is not a simple one. For didactic purposes it appears best to first construct an umbilicus, and then to view it from different aspects.

Fig. 5 shows after Waldeyer an anterior view of the abdomen of a new-born child, with removal of the entire anterior parietes, with the exception of the peritoneum. The umbilicus and the structures entering it have been retained.

Fig. 6 is an enlarged anterior view of the umbilicus diagrammatically presented, the shaded area representing Richet's fascia.

Fig. 7 shows after Waldeyer a posterior view of the anterior abdominal wall. Particular attention is called to the two obliterated umbilical arteries, the umbilical vein and urachus, and their junction at the umbilicus.

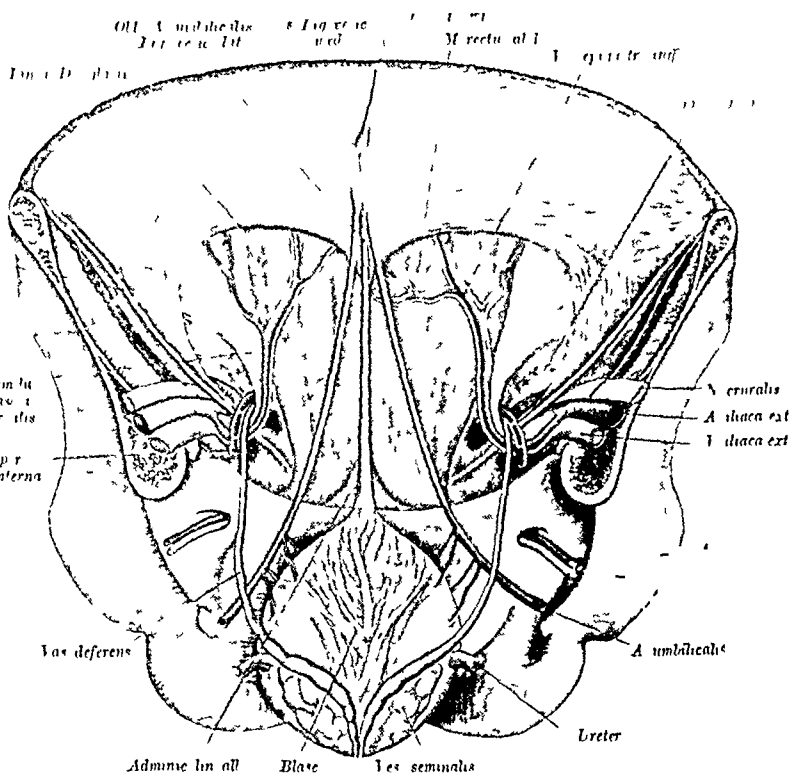


FIG 7 —Posterior view of anterior abdominal wall (Waldeyer)

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A horizontal cross-section through the upper part of the umbilicus would therefore have the appearance as shown in Fig 9. Note the single hole in the transversalis (Richet's) fascia made by the passage of the umbilical vein.

A similar section through the centre of the umbilicus, *i e*, where it is not pierced by any vessel, will appear as illustrated in Fig 10.

A horizontal cross-section through the lower part of the umbilicus, *i e*, at the level where the transversalis (Richet's) fascia is pierced by

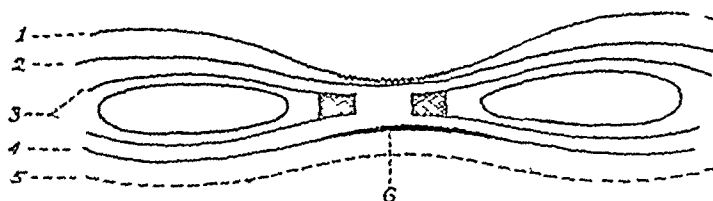


Fig 10

FIG 10 —Horizontal section through the centre of the umbilicus. 1, skin, 2, superficial fascia, 3, sheath of rectus, 4, transversalis fascia, 5, peritoneum, 6, Richet's fascia.

the two umbilical arteries and the urachus, will appear as illustrated in Fig 11.

And finally a section through the centre of the umbilicus in a vertical direction, being pierced only by the umbilical vein and the urachus, would appear as illustrated in Fig 12.

Figs 9, 11 and 12 are intended to show more particularly the hiatus in the transversalis (Richet's) fascia, wherever it is pierced by a blood-vessel or other structure. In previous articles I have frequently emphasized the fact, that such a hiatus exists in the fascia, when and wherever

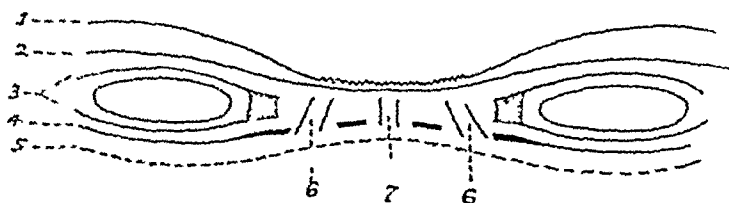


Fig 11

FIG 11 —Horizontal section through the lower part of the umbilicus. 1, skin, 2, superficial fascia, 3, sheath of rectus, 4, transversalis fascia, 5, peritoneum, 6, umbilical arteries, 7, urachus.

it is pierced by a blood-vessel, but in addition I have also pointed out the fact, that such a hiatus does not exist as a hole with sharply defined margins because at the exit of a vessel the transversalis fascia becomes everted, passes outward with the vessel, and becoming more and more attenuated, it finally merges with the wall of the vessel. Therefore in order to be correct Figs 9, 11 and 12 would have to be modified as in Figs 13, 14 and 15. Slight reflection will show the analogy to the infundibuliform fascia and sheath of the femoral vessels. No alteration

Fig 8 shows a cross-section of the umbilicus in a vertical direction. The principal object of the last diagram (Fig 8) is to illustrate the so frequently reiterated point, that all the vessels are situated between the peritoneum and the transversalis fascia. Such being the case, it

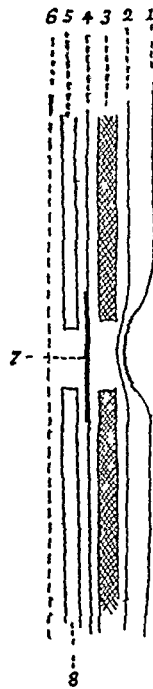


Fig 8

FIG 8—Vertical section of the umbilicus before the vessels have pierced the transversalis fascia 1, skin, 2, superficial fascia, 3 linea alba, 4, transversalis fascia, 5, umbilical vein, 6, peritoneum, 7, Richet's fascia, 8, urachus

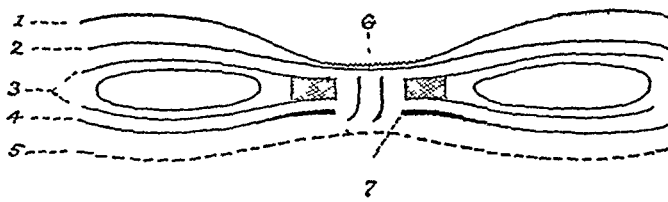


Fig 9

FIG 9—Horizontal section of the umbilicus in the upper part 1, skin, 2, superficial fascia, 3 sheath of rectus, 4, transversalis fascia, 5, peritoneum, 6, umbilical vein, 7 opening in Richet's fascia

follows, that before the umbilical vessels can reach the placenta, they must perforate the transversalis (Richet's) fascia. It has previously been shown that the vessels leave or enter the umbilicus only at two levels, namely, the umbilical vein superiorly, and the two umbilical arteries and urachus inferiorly. A section of the umbilicus would therefore materially vary, depending upon the level and direction of the particular section.

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the cord drops off there remains behind the so-called umbilical ulcer, the base of which is made up of superficial fascia, the stumps of the various structures which pass through it, and the small everted portions of the superficial fascia. After healing the resulting cicatrix lies directly upon and is adherent to these structures.

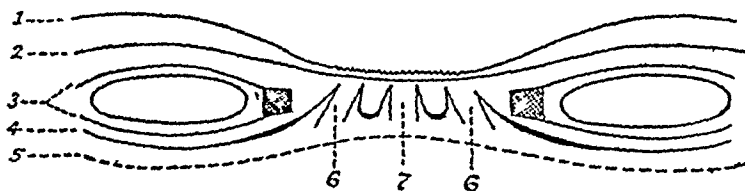


Fig 14

FIG 14 —Horizontal section through the lower part of the umbilicus, showing the outward prolongation of Richet's fascia upon the urachus and umbilical arteries. 1, skin, 2, superficial fascia, 3, sheath of rectus, 4, transversalis fascia, 5, peritoneum, 6, umbilical arteries, 7, urachus.

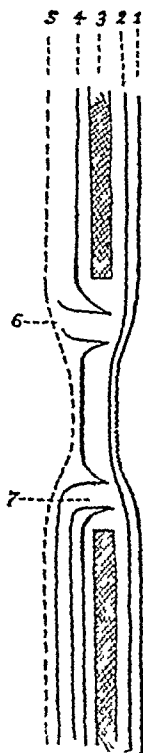


Fig 15

FIG 15 —Vertical section through the centre of the umbilicus showing the outward prolongation of Richet's fascia upon the umbilical vein and urachus. 1, skin, 2, superficial fascia, 3, linea alba, 4, transversalis fascia, 5, peritoneum, 6, umbilical vein, 7, urachus.

In order to illustrate these data Figs 13, 14 and 15 require the modifications as illustrated in Figs 16, 17 and 18.

If these illustrations are carefully studied, it becomes evident that theoretically it is possible to have a large variety of umbilical hernia.

- 1 A hernia through the opening for the right umbilical artery
- 2 A hernia through the opening for the left umbilical artery

is necessary in Fig 10, as at that particular level the transversalis fascia is not pierced by any vessel

Umbilical hernia differs in one special point from every other hernia, namely, that whereas in every other hernia the superficial fascia is merely stretched over the hernia, in umbilical hernia the superficial

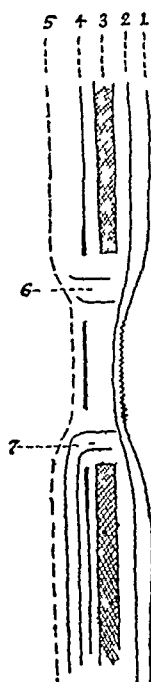


Fig 12

FIG 12 —Vertical section through the centre of the umbilicus 1, skin, 2, superficial fascia, 3, linea alba, 4 transversalis fascia, 5, peritoneum, 6 umbilical vein, 7 urachus

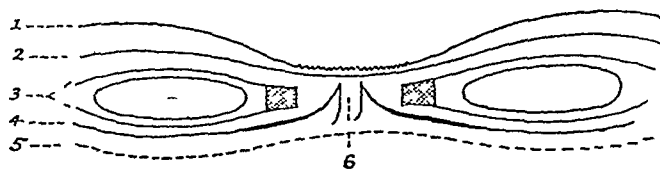


Fig 13

FIG 13 —Horizontal section through the upper part of the umbilicus, showing outward prolongation of Richter's fascia upon the umbilical vein 1 skin, 2 superficial fascia, 3, sheath of rectus, 4, transversalis fascia, 5, peritoneum, 6, umbilical vein

fascia is in addition pierced by the blood-vessels which pass through the umbilicus This comes about because the umbilicus is the only hernial aperture whose vessels no longer functionate, and which vessels actually leave the body to reach the placenta During the passage of the vessels through the superficial fascia, this structure, just as the transversalis fascia, also becomes everted, and becomes united to the vessels When

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A vertical section of the most frequent form of umbilical hernia would therefore be represented as in Fig 19

The coverings of such an umbilical hernia therefore are (1) Skin, (2) subcutaneous fat only in the upper part, none in immediate relationship with the hernia, (3) greatly attenuated superficial fascia, (4) greatly attenuated transversalis (Richet's) fascia, (5) peritoneum. Owing to the great thinness of these structures, practically all these layers are fused together

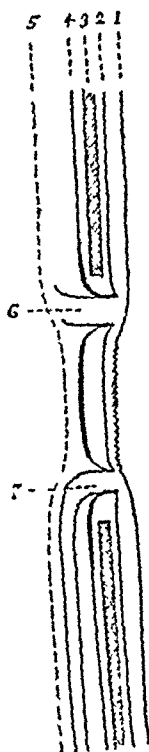


Fig 18

FIG 18—Vertical section through the centre of the umbilicus, showing the outward protrusion of Richet's fascia and of the superficial fascia upon the umbilical vein and urachus 1, skin, 2, superficial fascia, 3, linea alba, 4, transversalis fascia, 5, peritoneum, 6, umbilical vein, 7, urachus

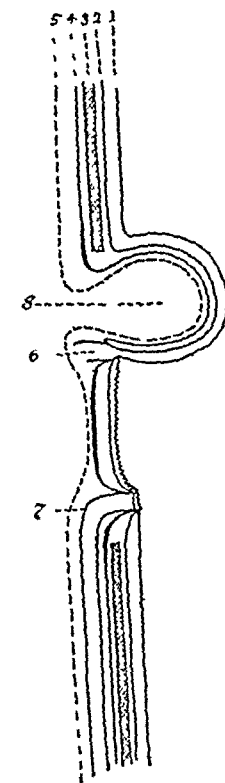


Fig 19

FIG 19—Vertical section of the most frequent form of umbilical hernia 1, skin, 2, superficial fascia, 3, linea alba, 4, transversalis fascia, 5, peritoneum, 6, umbilical vein, 7, urachus, 8, sac of umbilical hernia.

The writer does not intend to convey the impression that the anatomy and pathogenesis of umbilical hernia, as elucidated above, is of profound practical importance. The majority of the structures, as in inguinal or femoral hernia, are ruthlessly removed in the operation, indeed, to a greater degree. This is no reason, however, why the anatomy and pathogenesis of umbilical hernia should not be as carefully elaborated, as, for instance, the anatomy and pathogenesis of inguinal hernia. Up to the present, however, such intensive consideration has not been accorded to umbilical hernia.

3 A hernia through the opening for the urachus

4 A hernia through the opening for the umbilical vein

5 In the absence of a well-developed Richet's fascia, or when it is destroyed by pathological processes, we may have a hernia through the centre of the umbilicus, such a hernia indeed would be a true umbilical hernia

In practice, however, we find that by far the most frequent variety of umbilical hernia is that which utilizes the opening for the umbilical

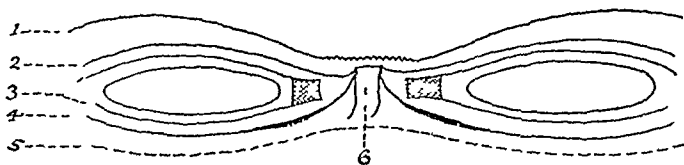


Fig 16

FIG 16 —Horizontal section through the upper part of the umbilicus showing the outward prolongation of Richet's fascia and of the superficial fascia upon the umbilical vein 1 skin, 2, superficial fascia, 3, sheath of rectus, 4, transversalis fascia, 5, peritoneum, 6, umbilical vein

vein for its exit. This is due to the following reasons. It has previously been shown that after ligation of the cord there is formed from the abundantly present embryonal tissue a mass of very firm connective tissue, which not only binds the two umbilical arteries and the urachus to the umbilical ring and abdominal wall, but also fills up the interstices between them, this is, therefore, an opening so well protected as to be only exceptionally causative of a hernia.

Furthermore, it was also pointed out, that the umbilical vein is

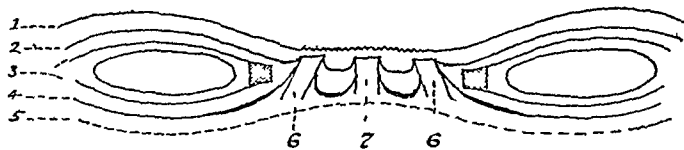


Fig 17

FIG 17 —Horizontal section through the lower part of the umbilicus showing the outward prolongation of Richet's fascia and of the superficial fascia upon the urachus and umbilical vein 1 skin, 2 superficial fascia, 3, sheath of rectus, 4, transversalis fascia, 5, peritoneum, 6 umbilical arteries, 7, urachus

deficient in this strong connective-tissue formation, indeed, the vein is being constantly pulled away from the upper margin of the umbilical ring by its attachment to the two arteries and urachus, so as to leave this portion of the linea alba practically unprotected. Even if no hernia is present the concave upper margin of the umbilical ring can frequently be palpated. This condition, so to say, invites the formation of a hernia, a fact well known already to Richet, who, for analogy's sake, called this part of the umbilicus the umbilical canal.

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course of operations upon other structures. Of these 13 cases, 4 were present in hernial sacs, and 2 were associated with ovarian cysts. Of the 68 cases, 9 were found in males, 8 in females, and in 51 the sex is not recorded. The cyst included the entire appendix in 11 cases, it was localized to a portion of the organ in 20, and in 37 no note was made as to whether it was general or local. The contents were described as being mucoid in 4 cases, gelatinous in 12, colloid in 4, fluid in 7, and in 4 cases there were carcinomatous areas present in the walls of the cysts. Of the 32 cases in which the age is recorded it is given as follows: between 1 and 10 years, one case; between 11 and 20 years, two cases; between 21 and 30 years, seven cases; between 31 and 40 years, eight cases; between 41 and 50 years, seven cases; between 51 and 60 years, seven cases. While the great majority recorded were not very large, some were notably so, such as the following cases: Wood's and Combemale's were 20 cm in length, Finkelstein's measured 15 cm by 14 cm, Montgomery's measured $5\frac{1}{2}$ by $4\frac{3}{4}$ in, the author's measured 30 cm along its great longitudinal curvature and 14 cm in its greatest circumference, Deaver's was the size of an orange, and the one recorded by Virchow was the size of the fist."

The above gives a splendid statistical summary of the condition.

CROUSE⁴ in 1910 has reported, along with tumors of the appendix, literary citations to fifty-four cases. He reports a total of 256 cases, but fails to give the sources from which all were obtained. He reports no new cases. Crouse also states that of the 256 cases 100 were noted as contents of hernial sacs, 4 were discovered during operations on other organs, and 152 at autopsy.

MCCONNELL⁵ in 1907 has added a very interesting chapter to this unusual disease. He reported a case of pseudomyxoma peritonei, occurring in a man, from a ruptured cystic appendix. He also found that Rokitanski,⁶ Draper,⁷ Vimont,⁸ Baillet,⁹ and Stengel² had reported similar cases. This condition is in every way similar to pseudomyxoma peritonei from a ruptured gelatinous adenocystoma of the ovary.

WILFRED TROTTER¹⁰ in 1910 reported a case of peritoneal pseudomyxoma originating from a ruptured cystic vermiform appendix in a man aged thirty-six.

THOMAS WILSON¹¹ in 1912 found a cyst of the appendix during an operation for fibroids in a woman aged fifty-two. He also reports a case in a woman aged sixty-eight, in which the cystic appendix was ruptured during examination, and operation for uterovaginal prolapse a short time later resulted in cure.

EDEN¹² in 1912 reported a case of pseudomyxoma of the peritoneum, arising from perforation of a gelatinous ovarian cyst and associated with similar cystic disease of the vermiform appendix. His patient was a woman aged forty-six.

FRITZ COLLEY¹³ in 1912 has discussed this type of appendix disease at length, and noted that Virchow found at autopsy an appendix dilated to the size of a man's head. He has also quoted Plem, in which case the cystic appendix the size of a walnut was imbedded in the wall of the cæcum.

HAMMESFAHR¹⁴ in 1913 reported two cases. The first case occurred in a 38 year old woman, giving a history of chronic appendicitis. At operation the appendix was found to be 5.5 by 13 cm in size and filled with gelatinous pseudomucin. The second case was operated upon for chronic appendicitis, and the appendix was found to be a pseudomyxomatous cyst measuring 3 by 12 cm. He also reported a case operated upon in 1910, in which the appendix had ruptured and produced a pseudomyxoma peritonei.

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BY OTTO L. CASTLE, M D

OF KANSAS CITY, MO

CYSTIC dilatation is a rare form of appendix disease. This disease has been designated by a number of different terms, as hydrops of the appendix, mucocele of the appendix, myxocoele of the appendix, pseudo-myxomatous cyst of the appendix, cystic appendix disease, etc. However, the original pathology for this condition is the same and various terms applied to it represent the different authors' terminology. In reviewing the literature, the following is compiled from post-mortem reports of various authors:

Observer	Postmortems	Cases
Ribbert	400	6
Bryant	124	1
Steiner ¹	2286	3
Brody	528	1
Boston City Hospital	3770	16
Stengel	2000	1
Heineck	3550	0
Castle	500	0
Total	13158	28

This gives a total of 13,158 post-mortem records, in which 29 cases of cystic dilatation of the appendix were observed, or about 2 per cent.

STENGEL² in 1906 has given a very comprehensive review of the literature, in which he collected a total of 28 cases. He also reported his case in detail, which was revealed at autopsy in a 50-year-old woman, who died of diabetes. The appendix was 6 cm long and about 2.5 cm in diameter. The entire wall and mucosa were atrophic. The contents were grayish-white, gelatinous material, which, upon chemical analysis, was shown to be pseudomucin, containing calcareous deposits.

J. A. KELLY³ in 1909 has also contributed a very valuable article on this subject. In addition to Stengel's 28 cases, he was able to collect from the literature 43 cases, bringing the total up to 71. He also gives a very complete bibliography. His case was revealed at postmortem in a 43-year-old colored woman. The appendix was banana-shaped and measured 30 cm along its greater curvature. The contents consisted of grayish, jelly-like pseudomucin. The following is taken from Kelly's report and is the resume of the cases from the literature:

"A summary of the cases found in the literature and that of the author, in all 68 cases, shows the following facts: 33 cases were observed at the operating table, 18 were found at autopsy, and in 17 the method of observation is not recorded. Of the 33 cases observed at the operating table there were symptoms of appendicitis in 20. In 13 cases the cyst of the appendix was found during the

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in the literature do not show to what extent the appendix is usually involved. A number of theories have been presented to explain the mode of occlusion. (1) The valve of Gerlach may completely close off the appendix from the cæcum, and the secreting mucosa, being active cyst formation, results. (2) Focalized ulcerative appendicitis may produce destruction of the mucosa with formation of cicatrix, which in turn may contract to produce complete occlusion. (3) External mechanical conditions, among which may be mentioned (a) a short mesentery to the appendix with resulting kinking, (b) an immobilized, retroperitoneal placement, in which position gaseous or fecal distentions of cæcum may completely close off lumen of appendix (Heinick noted this position 12 times in 3550 autopsies), (c) appendicitis with resulting immobilizing parietal or visceral adhesions, (d) adventitious membranes or bands about cæcum.

Of these theories the most logical in the author's opinion are those of focalized ulcerative appendicitis with cicatricial obstruction, or malposition of the appendix. Most of the cases reported in the literature do not record the fact that these cases show evidence of acute or subacute inflammation, but that the process is a very chronic one and peritoneal surfaces are smooth.

Pathology—Microscopic findings are of much interest. The cyst wall in places may be very thin and the muscle fibres may be entirely or in part replaced by connective tissue. The mucosa is usually very much thinned and in places may have undergone complete atrophy. The columnar epithelium is flattened to a cubical shape or may be absent. The glands also in most cases have undergone marked atrophy. There is present a profuse round-cell infiltration throughout the walls. There are noted calcareous deposits in the different atrophic layers. The contents of the cysts is described as gelatinous, mucoid, etc., and is of grayish translucent color. Microscopically, there may be found in the cyst content an occasional stellate or round cell, but for the most part is a nondescript granular material. Chemically, there may be demonstrated calcareous fragments through the contents, which probably accounts for the turbid grayish appearance imparted to it. Careful chemical analysis of the cyst contents proves it to be pseudomucin.

Diagnosis—The diagnosis of this condition is difficult. A tumor presents in the right lower quadrant of the abdomen, which is elastic and movable to varying degrees unless it is of the retroperitoneal type, in which case it is fixed. This must be differentiated from a tense, distended cæcum, a dystopic kidney, a hydrosalpinx and retroperitoneal cyst. A definite diagnosis, as a review of the literature reveals, has

MATAS¹⁵ in 1914 reported before the Southern Surgical Association his observation of a case of large myxoid cyst, multilocular, retroperitoneal and retro-cæcal, weighing 1582 grammes, in a man aged twenty-five. The appendix was attached to the mass but was distinctly not involved in the cyst formation, and Matas concluded that it probably came from some abnormal embryologic remains in the mesentery.

PHEMISTER¹⁶ in 1914 reported before the Chicago Surgical Society retention cyst of the appendix, presenting three specimens. The first case was diagnosed ovarian cyst in a thirty-six year old woman. At operation a large, sausage-shaped cyst of the appendix was found, measuring 17 cm in length and 21 cm in greater circumference. The second was obtained in 1907 from a forty-six-year-old woman suffering from left inguinal hernia. Operation revealed a large, ruptured, cystic appendix with gelatinous pseudomyxoma peritonei. Surgical removal and drainage cured the patient. The third case was a pseudomucinous diverticulum of the appendix, the size of a grape fruit, in a woman forty-six years old. This case has been previously reported by Herb. At the same meeting Percy presented a specimen of a large cystic appendix removed from a patient fifty-five years old, who had gall-stones. The appendix measured 6 cm by 14 cm and contained a gelatinous fluid. He also reported finding another case almost as large, but unfortunately the specimen was lost.

HARTMAN and KINDLEY¹⁷ in 1914 have reported a case in a negress aged forty-eight. This appendix measured 11 cm in length by 5 cm in its greatest diameter, and was filled with pseudomucin. The authors also cite Corning's¹⁸ report of 4 cases from 735 appendixes removed at operation and sent to his laboratory.

FOWLER¹⁹ in his volume on appendicitis records a case in which there was a nodule the size of hen's egg behind the internal abdominal ring. Operation revealed an S-shaped appendix with a cystic dilatation of the proximal end the size of a walnut.

H A KELLY²⁰ in his work on appendicitis cites the case of Sonnenburg, in which there was a pear-shaped cyst of the appendix 14 cm long and 21 cm in circumference. The walls were atrophic and the epithelium was reduced to a low columnar type. There was also present abundant round-cell infiltration in the walls. His illustrations are splendid and he also pictures two cases from his collections.

Symptoms—As a study of the literature reveals, this condition rarely produces symptoms. Most of the cases were revealed post mortem or were discovered during operations for other conditions. However, a few reports indicate that the patients suffered from symptoms of chronic appendicitis. The most frequent diagnosis, when made, was ovarian cyst of fibroids.

Etiology—The essential factor concerned in the production of cystic appendix disease is obstruction of the lumen. The obstruction may occur at any portion and produce a cyst distal to the occlusion. Thus, the proximal portion of the appendix may be of normal dimensions, while the distal end may be enlarged to varying degrees. Records

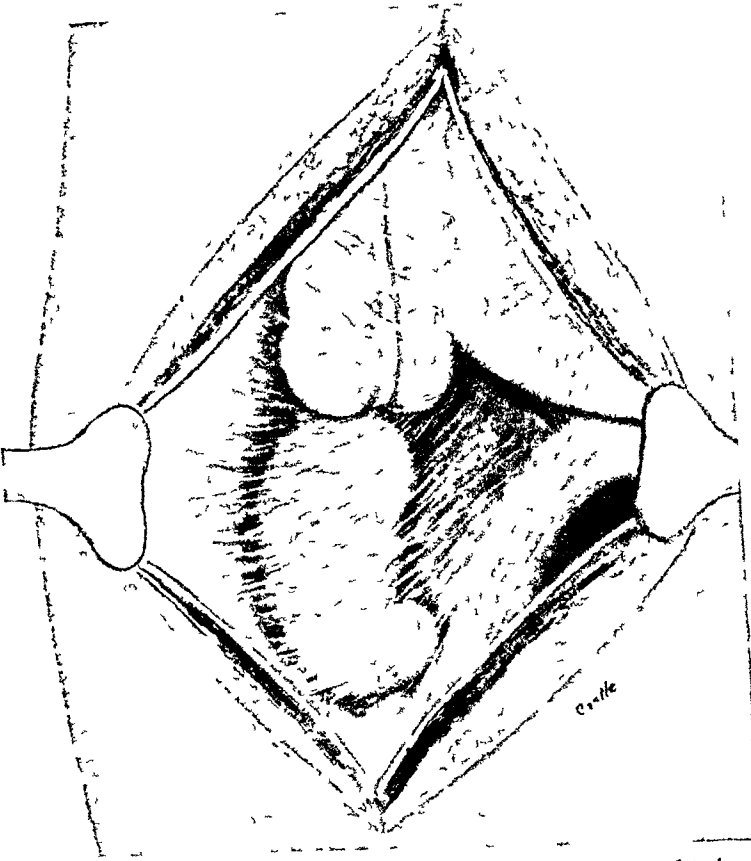


FIG 1 —Showing cystic appendix, retroperitoneal and lying in right iliac fossa

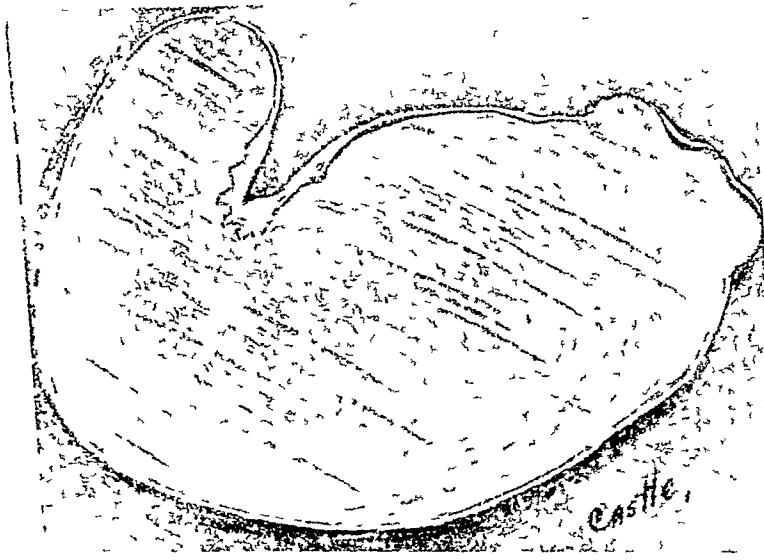


FIG 2 —Showing cystic appendix cut open longitudinally. Note that contents consist of semi-translucent pseudomucin with clouded strata

rarely been made, and has usually been mistaken for ovarian cyst, fibroids, etc. Many of the cases were discovered at autopsy or during operations upon other organs

CASE REPORT—The following is the case report upon which this contribution is based. P. H., male, aged thirty-three, farmer, Liberty, Mo., referred by Dr. R. E. Sevier.

Family History—Negative

Personal History—Pneumonia at two years with good recovery. Had the usual children's diseases with good recoveries. Typhoid fever 5 years ago, at which time he was sick in bed for six weeks but made good recovery. This is the only illness in adult life up to the present trouble. His digestion was good until about one year ago, since which time he has been troubled with indigestion. No constipation. Weight was constant until about six months ago, since when he has lost ten or fifteen pounds. Has never been jaundiced, and has had no abdominal pain to present trouble. Negative urinary history.

Present Trouble—This began insidiously ten or twelve months ago by pain in right lower quadrant of abdomen. Probably no fever, no chills, no vomiting. Appetite became poor and he would eat about one-half his former meal. Eleven weeks ago he had a spell of pain in right lower quadrant of abdomen, which lasted for two weeks. Nine weeks ago he had a sudden attack of painful and frequent urination, which lasted for a few hours and then pain settled again in right lower quadrant. Urine contained no blood. He had some fever but no vomiting, and remained in bed three hours. He did his usual farm work under protest until ten days ago severe pain began again in right lower quadrant which prompted him to call Dr. Sevier, who had to give him a hypodermic for relief. At this time was in bed one day. Two days ago he had another spell, which required a hypodermic to relieve it. Urinary examination is entirely negative, with the exception of a fair amount of indol. He came to the hospital on June 2, 1913.

Physical Examination—Reveals a well nourished adult man with a palpable, elastic mass in right iliac fossa, slight tenderness. Otherwise the patient was in good physical condition.

Operation—Operation was performed on June 3, 1913, at which time laparotomy was done through a right rectus incision. At the base of the cæcum no appendix was found, but instead a retroperitoneal elastic tumor was found lying in the right iliac fossa (Fig. 1). The peritoneum was split, revealing a whitish, opaque, comma-shaped, elastic tumor with attachment to cæcum.

CYSTIC DILATION OF THE VERMIFORM APPENDIX

at normal appendix site It was enucleated readily and was carefully dissected from attachment to cæcum without rupture or penetration of gut wall A few sutures plicated the site of the cæcal attachment and the peritoneum was repaired The incision was closed in the usual manner, and the patient made a rapid and uninterrupted recovery

Gross Pathology—The specimen consists of a distorted-cystic appendix, comma-shaped and measuring 5 cm in diameter and 7.5 cm in length with circumference at middle 16 cm, weight, 152 grammes Upon longitudinal incision the content of the cyst is found to consist of grayish, semi-transparent, gelatinous material (Fig 2) The substance bulges over the edges of the cut wall There are whitish, cloudy strata in the substance of the cyst content arranged radially from the lesser curvature of the wall, at which point the wall is thickened to about 2 or 3 mm The remainder of the wall is almost paper-thin and measures from $\frac{1}{4}$ to 1 mm in thickness There is evidence at the upper pole at cæcal attachment of a moderate herniating of the wall, where it is found the circular fibres are absent and only the longitudinal remaining

Histopathology—The wall of the appendix has undergone marked atrophy The mucosa is absent and the submucosa and muscularis have been replaced by fibrous tissue At one portion on lesser curvature the wall remains to the thickness of 3 mm, and here is noted a small area where the mucosa, glands and submucosa are still present (Fig 3) The epithelium is flattened to a cubical shape, the glands are few, and there is present a pronounced diffuse round-cell infiltration When this was cut through with a knife there was a grating sensation, and microscopic investigation revealed a plentiful distribution of lime salt deposits Section of the gelatinous substance shows a finely granular aplastic matrix with fine granules of calcareous salts This was more marked near the remnant of secreting mucosa and was also found to be more abundant in the clouded, opaque strata in the jelly-like contents Chemical examination of the cyst contents gives characteristic reactions for pseudomucin It is impossible to state the exact etiologic factor in this case, but it is probable that typhoid ulceration of the appendix occurred during his attack five years ago and complete occlusion resulted from the cicatricial contraction at site of ulceration

CONCLUSIONS

- 1 A rare form of appendix disease, available post-mortem records showing it to be present in about 2 per cent of cases
- 2 Total number of cases reported in the literature is from about 85 to 256 (Crouse)
- 3 Usually symptomless and benign but may, upon rupture, produce pseudomyxoma peritonei in every way similar to that of ovarian cyst origin

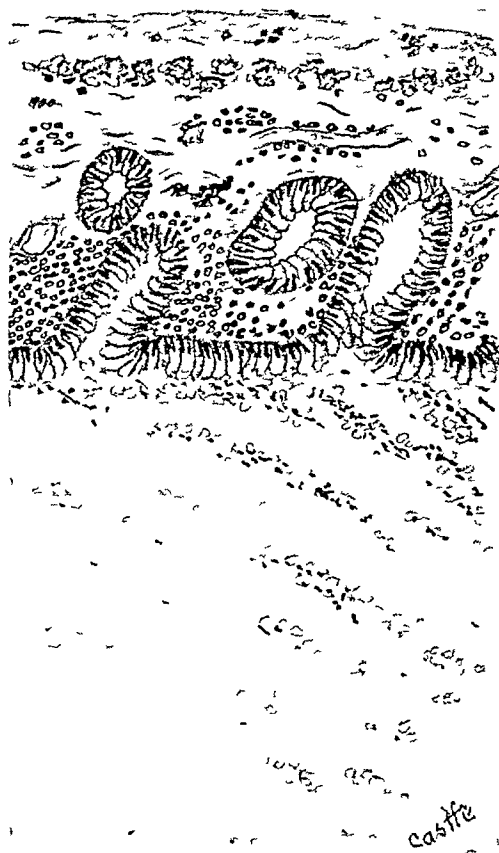


FIG 3 —Drawing showing histopathology of wall. Note the round cell infiltration, atrophic muscularis without peritoneal coating and atrophic mucosa and submucosa. Also note calcareous deposits in wall and aplastic contents of cyst which is pseudomucin.

PYLEPHLEBITIS COMPLICATING APPENDICITIS

By EDMUND ADAM BABLER, M.D.

OF ST LOUIS, Mo

VISITING SURGEON, CITY HOSPITAL, SURGEON, DEACONESS HOSPITAL

ACUTE appendicitis is such a frequent disease and the complications are so grave that practically every person has been taught the necessity of operation. There seems to be some question in the mind of some of the laity as to when the operation should be performed. In view of the distressing complications which not infrequently follow an infection of the appendix, and since immediate operation will prevent this disaster and avoid recurrence and will save every patient, providing infection has not extended beyond the appendix, it is evident that the laity should be taught to request immediate removal of the appendix as soon as the diagnosis has been made.

Prior to the classic work of Fitz, Munro, Murphy, Fowler and other American surgeons, it was customary to regard perforative peritonitis as the most frequent and grave complication of appendicitis. Incision, postural drainage, proctoclysis and gastric lavage have succeeded in reducing the mortality to practically *nil*. Murphy deserves special credit for these brilliant results. During the past four months I have operated ten cases in point with two deaths, both fatal cases were practically moribund at time of operation and were regarded as hopeless. I have found adrenalin chloride, in half-drachm doses given intravenously with four ounces of distilled water, to be of very great service in these desperate cases. The injection should be repeated in six hours.

With the almost practical elimination of perforative peritonitis I believe that the most grave present-day complication of appendicitis is pylephlebitis with multiple abscesses of the lung or of the liver. Although Waller's historic first case of appendicitis complicated with multiple abscesses of the liver was reported in 1847, a careful study of the literature shows that we have not accorded due consideration to this important subject. Pylephlebitis occurs with greater frequency than we have appreciated. Many of the cases recover without our having recognized the presence of the complication, many patients die without our having correctly interpreted the clinical picture. Murphy maintains that multiple abscesses of the liver are a rare complication of appendicitis. Ochsner, Deaver and several other prominent American surgeons have not seen more than one case. In 1903 Gerster reported 1189 operative cases of appendicitis, in 9 of which pylephlebitis was present.

4 A retention cyst of the appendix of variable size and in which various portions of the appendix may be involved

I wish to express my thanks to Dr Jabez N Jackson for the surgical aspects of the case herewith reported

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phasized the finding that severe pain was the one symptom which pointed to the location of the abscess Gerster mentions the fact " that chills accompanied by a rapid rise of temperature, observed during the course of an appendicitis, however mild as to the local symptoms, may and usually do signify the entrance of septic material into the portal and general circulation They must be looked upon as, a sign of the greatest import Should the seizure pass into a continuous fever with dry tongue and retching, a clouded sensoria, with a rapidly rising pulse of deteriorating volume and quality, the body temperature remaining above 103° F, with a tendency of mounting as high as 106° or higher, the diagnosis of acute septicæmia will be justified "

One of the earliest and most impressive diagnostic signs of portal infection is repeated chilly sensations or distinct chills, chill is followed by high pulse-rate, marked elevation of body temperature and profuse sweating When the above symptoms follow in the wake of the early clinical manifestations of an acute appendicitis and are associated with persistent pain in the region of the liver, jaundice, general depression, septic tongue, the finding of urobilin in the urine, and marked tenderness in the hepatic area without signs of peritoneal or pleural involvement we may feel quite confident that the patient is suffering from septicæmia due to multiple abscesses of the liver Pain is a very constant symptom and precedes the jaundice Local œdema may be present

In my case of multiple abscesses of the lung, the repeated chills associated with a septic temperature and persistent cough were prominent symptoms The site of the severe pain was a valuable indication of the location of the abscess Change in the respiratory murmur appeared at site of pain several days before percussion revealed any change

In a typical case of multiple abscesses of the liver complicating appendicitis the diagnosis should not be difficult In any given case the diagnosis must rest on (1) the history showing that the appendix was the primary seat of trouble, (2) the shifting of the symptoms from the appendix to the hepatic region, (3) the progressive increase in the severity and character of the symptoms, (4) the repeated chills followed by high pulse-rate and marked elevation of body temperature, (5) the jaundice, (6) the persistent pain in the hepatic region, (7) the urinary and blood findings, (8) the change of liver dulness, (9) the picture of marked toxæmia, and (10) the absence of the signs and manifestation of extensive peritonitis. Munro is, I think, correct in maintaining that *the most important clue in making a diagnosis is the recognition of the causative appendicitis* The fact that an appendicitis patient is suffer-

Gerster's classic paper deserves careful study. In 1905 Munro reported 15 cases of undoubted portal infection, although Krogius observed this complication in only 2 of his 1000 cases of appendicitis. Bell cites 1726 cases, in only 8 of which was the complication present. Korte recently attracted considerable attention to this subject, and his pioneer surgical work in this field deserves special mention. Korte cites 16 cases in point. Franke's recent monograph is very interesting.

The pathology is quite clear. It is important to remember that the abscesses are practically always multiple. Kelly thought that the complication was always a late one, although his contention is not borne out by experience. The abscesses vary in size, the right lobe is more frequently involved than the left. This is explained by anatomic conditions. Barker refers to several cases in which the infection spread along the lymphatics of the appendix and produced very grave conditions in the glandular and areolar tissue behind the abdominal peritoneum without any local or general peritonitis. In 1893 Shoemaker emphasized the fact that abscesses of the liver following appendicitis are usually small and multiple, and that they are not always due to continuous spread of inflammation to the portal veins, but that they might be due to embolism. In my case of liver abscesses the infection was of the portal variety. Munro was inclined to believe that the appendices that originally are extra-abdominal and without any peritoneal covering are presumably less able to direct the lymph currents within the normal channels, and so give rise to the most fulminating types of lymphatic poisoning. Portal infection is the most frequent source of intrahepatic abscesses. Porier and Cuneo found that the normal termination of the lymphatics from the appendix and cæcum is the glands of the ileocæcal group. Infection may travel from the subphrenic space to the liver, forming secondary abscesses in the liver. In Thompson's interesting case of portal infection, the liver was free from abscesses, although the branches of the portal vein in the liver substance were filled with pus. In 1875 Legg exhibited a case of infection where there seemed to be evidences of healing in some of the hepatic abscesses. Reichardt has expressed the belief that these abscesses may heal by encapsulation.

The most frequent clinical manifestation of multiple abscesses of the liver complicating appendicitis is repeated chilly sensations or distinct chills followed by very high temperature and profuse sweating, and associated with the presence of urobilin in the urine and persistent icterus. Franke was impressed with the fact that urobilin disappeared from the urine as soon as the last abscess had been opened. He em-

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1913, patient complained of usual symptoms of appendicitis, he gave history of previous attacks, was admitted to the Deaconess Hospital February 7, 1913, at which time his pulse-rate was 100 and temperature 101° . Operation was performed by Drs Keiser and Hamm on the following day, and an adherent appendix was removed, pus was not noted, appendix was ruptured during removal, tube drainage. Patient did not make the usual prompt recovery. On the day following operation his temperature registered 101° , and pulse 98. On the fifth day post-operative he complained of severe pain in the region of right lobe of liver. Drainage very scant and tube was removed. Six days after operation and on the day following the severe pain in hepatic region patient suffered a *severe chill*, two hours later he had a second chill, and four hours thereafter a third chill. The first chill was followed by a temperature of 104° ; the second chill was followed by a temperature of 101° , in neither instance was the fever followed by profuse sweating. Two days after first chill the patient had his fourth chill, this latter was followed by a temperature of 104° and a pulse-rate of 120, no sweating. Quinine was administered and no chill was noted for seven days, although patient continued to complain of more or less constant and severe pain in the region of the gall-bladder. On February 24 the fifth chill occurred, temperature registered 101° , patient complained of very severe pain in region of gall-bladder, nausea and vomiting were prominent symptoms. One week thereafter the seventh chill was recorded, pulse 120, and temperature 103° , patient perspired freely thereafter and vomited large quantity of bile. Dr Hempelmann was called in consultation, and recommended that a surgical consultation be held.

The writer saw the patient at this time, just a month after the onset of symptoms. Patient was complaining of excruciating pain in region of gall-bladder, expression anxious and drawn, markedly jaundiced, temperature 102° , pulse 112, abdomen not distended, operation wound was still open, but discharging only a slight amount of a seromucoid substance, area of liver dulness increased, exquisite tenderness in gall-bladder region, thoracic findings normal, no evidence of subdiaphragmatic abscess or abscess in renal pouch. The possibility of hepatic abscess and of empyema of gall-bladder were considered. The patient appeared to be in a very desperate condition, he was septic and an immediate exploratory operation was recommended by Dr Hempelmann and the writer.

A very tense and greatly enlarged gall-bladder was found, the liver was not adherent to the diaphragm, and abscess was not demonstrable, the lymphatics extending from the meso-appendix

ing from repeated chills followed by high temperature and profuse sweating indicates clearly the gravity of the situation and points to a septic condition somewhere, when the physical findings point to the liver, it is time to consider immediate exploration. I am not a supporter of the aspiration needle prior to exposure of the liver, unless preparations have been completed for immediate intervention in case aspiration locates the pus.

The prognosis of the complication in point is necessarily grave. Prior to the pioneer work of Korte and Franke the complication was regarded as practically always fatal. Lemarie's experiments indicate that the liver offers to the colon bacilli protection against a general infection up to a certain extent. Munro held that this fact bears out the belief that spontaneous healing in liver abscesses is not impossible nor even infrequent in cases of mild infection, and that this is shown by the recovery at times of patients who present the typical signs and symptoms of hepatic abscesses in the course of an appendicitis. In 1875 Legg exhibited a case of infection where there seemed evidence of healing in some of the hepatic abscesses. Thompson's finding that portal infection may occur without the formation of liver abscesses even though the branches of the portal vein be filled with pus would tend to explain Munro's recovered cases of supposed hepatic abscesses. The prognosis in any given case in point depends on (1) the size, multiplicity, and location of the abscesses, as well as their accessibility from a surgical stand-point, (2) the time of their discovery, and (3) the general condition of the patient together with the character and time of the treatment.

The treatment of pylephlebitis with multiple abscesses of the lung or of the liver is quite clear. The appendix should be removed, the infected lymphatics leading from the appendix to the liver should be incised and drained, and the liver should be exposed and the abscesses located and also drained. The abscess or abscesses in the lung must be located and drained. The intense pain will frequently guide the surgeon to the site of the abscesses. I do not feel that it is advisable to aspirate the liver until the latter has been duly exposed, unless preparations for immediate intervention have been completed. I am a strong supporter of the lumbar drain in these cases.

REPORT OF CASES

CASE I—C E, age forty, white male, was seen in consultation with Drs Hamm, Keiser and L H Hempleman to whom I am indebted for the following history. Illness began February 2,

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which attack the abscess ruptured into a bronchus and death followed Autopsy refused

CASE III—This patient was under the care of Dr James Stewart and was seen by me through the courtesy of Dr Stewart and Dr Roland Hill The patient was seen by Dr Hill ten days after onset of symptoms of acute appendicitis The patient had refused early operation On the tenth day the patient complained of severe pain in region of left nipple, the pulse rose from 100 to 130, and the temperature which had been between 99° and 100° rose to 103° F, respiration 36 Five days later the liver became markedly tender and enlarged, jaundice present Several days later, Dr Hill resected portions of the seventh and eighth ribs and evacuated six ounces of pus from chest Five days thereafter the first chill appeared, a few hours later the second chill occurred, and the temperature rose to 105° , pulse 140, and was followed by profuse sweating and gradual decline of temperature to subnormal Emaciation, progressive weakness, irregular chills and temperature reading, profuse sweating, jaundice, and pain in region of liver were prominent symptoms, and the picture in general pointed to abscesses in the liver Second operation was performed and liver was aspirated repeatedly but without success Autopsy showed liver studded with very small abscesses, one abscess was about the size of a hen's egg, the veins of right lobe of liver were filled with pus, in the blood of the heart were found short chains of streptococci, the appendiceal submucosa showed small areas of necrosis, and the cavity at the distal portion of appendix was dilated and filled with disintegrated material

Remarks—These three cases demonstrate the distressing and grave character of the complication in point They exemplify the fact that the secret of success in the treatment of appendicitis to-day is immediate removal, removal before the infection has passed beyond the walls of the organ in question *Active purgation has no place in the treatment of acute appendicitis* Enemata and ice combined with proctoclysis and Fowler's posture yield the best results whenever operation has been refused

My first case demonstrates the fact that the classic symptoms are not always present, the chills do not always recur at regular intervals, and sweating may be a late symptom Pain, jaundice, irregular temperature reading, exhaustion, and increased liver dulness directed us to the liver and gall-bladder. It is possible that if we had incised and drained the lymphatics and infected vessels it might have prevented the formation of abscesses in the liver and relieved the patient Of

to the liver were very much enlarged and very firm. The renal pouch was free from pus, there was no evidence of a subdiaphragmatic abscess. It was concluded that the liver abscesses were of the minute and multiple kind and a very unfavorable prognosis was given. Five days thereafter the patient began to cough, and examination of right chest showed slight effusion and marked increase in area of liver dulness. The chest cavity was aspirated and a clear fluid obtained. A second aspiration was made and the diaphragm was perforated and the needle introduced into liver substance, pus and bile were found. Immediate operation was performed and four separate and distinct abscesses of about the size of a small guinea egg were located in the right lobe of the liver. These were drained. The patient did well for six days, then became delirious and gradually sank. The body was shipped before examination could be made.

CASE II—G S, white male, aged forty-two, was seen in consultation with Dr Bewig on the third day of an acute attack of appendicitis. History of previous attacks. The clinical findings indicated a perforative peritonitis. Immediate operation showed appendix perforated and abdomen filled with pus. Postural treatment and proctoclysis were followed by satisfactory results until the fifth day, when patient complained of a dry, persistent cough and chilly sensations, pulse and temperature showed marked excursions, sweating was profuse. Patient lost flesh rapidly and could not sleep on account of the persistent cough. Delirium was noted. The abdominal symptoms disappeared rapidly and drainage was practically nil after the tenth day. On the twenty-first day post-operative the patient complained of severe pain in the region of the right nipple, although the physical findings were negative. Three days later aspiration revealed pus. Operation showed abscess of lung. The cough and sweating persisted. Liver was exposed under local anæsthesia and aspiration failed to locate pus. The following day patient complained of severe pain in region of angle of right scapula, two days later auscultation and percussion showed evidence of abscess, aspiration revealed a pocket of pus. The abscess was in the lung tissue. During the succeeding five days the patient seemed to improve. He then complained of dyspnoea, and severe pain in upper part of right lung, but repeated aspiration was not successful in locating the abscess. The patient became markedly exhausted. No pain in region of liver or in abdomen was complained of. The temperature fluctuated between 99° and 101°. Pulse was always very rapid and flickering. Dyspnoea increased and relatives refused further aspiration. Ten days after onset of final symptoms, the patient was suddenly seized with a severe spell of coughing, during

A NEW METHOD OF LATERAL ANASTOMOSIS OF BLOOD-VESSELS AND AN OPERATION FOR THE CURE OF ARTERIOVENOUS ANEURISM*

BY J. SHELTON HORSLEY, M.D.

OF RICHMOND, VIRGINIA

LATERAL anastomosis of blood-vessels is used either in uniting a vein to a vein, as in the Eck fistula when the portal vein is joined to the vena cava, or in uniting an artery to a vein when it is necessary to reverse the circulation. The indications for Eck fistula are few, if any, so far as its clinical application is concerned. The operation was described by Eck, a Russian surgeon, in 1877 and again in 1879. It has been performed a few times by German surgeons in cirrhosis of the liver (Rosenstein, German Surgical Congress, 1912), but the metabolic products from the portal circulation sooner or later produce a toxic effect when discharged into the general circulation at a rate as great as the Eck fistula permits. Again, it is possible that the ascites may be due to irritation of the peritoneum and not solely to portal obstruction.

The indications for reversal of the circulation are still under much dispute. Halstead and Vaughan (*Surgery, Gynecology and Obstetrics*, January, 1912) reviewed the literature and reported personal experiences. They conclude that the operation for reversal of the circulation has no practical value. Coenen, of Breslau, opposes the operation and gives his reasons at some length. They are that the valves must be forced, that it is probable the arterial blood following the route of least resistance goes through the first anastomotic vein back to the heart and rarely if ever reaches the terminal branches of the vein, that in arteriovenous aneurism it takes weeks and sometimes months for valves to be forced sufficiently to detect pulsation in the smaller veins, and that the arterial blood in venous capillaries must have some manner of return which has not yet been fully studied. There are many pathological conditions in man, such as arteriosclerosis, thrombo-angitis obliterans, diabetes, Raynaud's disease, that do not occur in experimental work. When the vessel itself is diseased at the site of the anastomosis,

* Read before the Southern Surgical and Gynecological Association, December 15, 1914.

course this is only a conjecture, since the infection may have advanced to the liver before operation was performed

Case two is a typical case of multiple abscesses of the lung complicating appendicitis. I did not find more than a single similar case in the literature. It exemplifies the danger of these abscesses rupturing into a bronchus. It is to be regretted that an autopsy could not have been obtained.

Case three is a quite typical case. The repeated chills, wide excursions of pulse and temperature reading, the site and character of the pain, the jaundice and the emaciation were quite characteristic. The abscesses were so small and so numerous that a successful issue was impossible.

Surgery is destined to bring relief to many of these grave cases in which the abscesses are superficially located and the medical attendant is sufficiently familiar with the clinical picture to detect the probable location of the pus. So much depends on the severity of the infection, the number, size and location of the abscesses. Korte has demonstrated the possibility of successful intervention in some of the seemingly hopeless cases so that the surgeon is justified in giving the unfortunate sufferer the possible benefits of an exploratory operation. Local anaesthesia may be used in many of these cases.

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LATERAL ANASTOMOSIS OF BLOOD-VESSELS

French intestinal needle with double thread Another row of sutures is made parallel with this, and an especially constructed scissors with sharp points is partly opened, one blade plunged into the vena cava, and the other into the portal vein The partition between the two rows of sutures is then cut A previously inserted suture is quickly tied at the point of the puncture of the scissors They claim that Eck fistula in dogs is consistent with life for a long period of time provided the diet is regulated, though certain hepatic functions are decreased when an Eck fistula is present, notably, tolerance for sugars, the formation of bile, and the hæmolytic function of the liver

The technic of Bernheim is similar to that of Sweet, who, in 1904, described a method in which a fine platinum wire was passed into the veins and an electric current connected, after the two rows of sutures had been placed, so burning an opening

The technic of Carrel and Guthrie involves dissecting the vena cava and the portal vein and clamping them above and below the site of operation, which is difficult and tedious The union is made with straight arterial needles

If a lateral anastomosis is to be done on easily accessible vessels, the operation is simple, but if the vessels are difficult to expose, or if hæmostasis cannot be complete, it becomes very trying In an effort to standardize a technic that could be used in all cases of lateral anastomosis, whether in making an Eck fistula, or in uniting an artery and vein in a difficult location, I have devised a forceps that takes a lateral hold either on the entire caliber of each vessel, or on any portion of it as desired The necessity for such a forceps was suggested by an operation done by me at the clinic of Professor W L Rodman, in Philadelphia, through the courtesy of Professor Rodman The case was an arteriovenous aneurism of the femoral artery and vein, too close to Poupart's ligament for the application of a tourniquet After dissecting the artery and vein above and below the aneurism, placing Crile clamps on these vessels above and below the lesion, clamping the profunda and controlling the internal branches, an attempt was made to dissect behind the aneurism This was difficult and bloody, but it was thought that the blood was what remained in the sac and tissues An incision into the communication between the vessels was followed by profuse bleeding that was controlled with considerable difficulty It was suggested by Prof Rodman and by Dr Stewart Rodman, who kindly assisted in the operation, that a forceps that could clamp these vessels before dividing them would be advantageous On looking up the matter afterward, I found three kinds of forceps for clamping

or when the veins are involved in the disease, reversal of the circulation is useless. When gangrene has already occurred, of course operation for reversing the circulation cannot bring relief.

The practical utility of reversal of the circulation is doubtful. Some experiments which I have recently performed and which are not yet ready for full report seem to show that in reversal of the circulation the blood returns to the heart by anastomotic venous branches a short distance below the site of the operation, and that the arterial blood in a reversed femoral vein does not reach the foot and usually goes but little below the knee.

If the circulation is to be reversed, it should be done by lateral anastomosis and not by an end-to-end union. When the vein and artery are both cut across and the artery united to the vein end-to-end, the remaining channel of the artery is sacrificed, whereas if lateral anastomosis is performed and the vein ligated on the cardiac side, there will be two channels for the arterial blood instead of one. The original arterial channel is not put out of commission and at least no harm will be done even if no good is accomplished. This was originally pointed out by J. B. Murphy and has later been demonstrated and insisted upon by Bernheim and others.

When the main artery to a limb is partially occluded and the veins are healthy, the arterial blood in the capillaries is probably drained off more quickly than normal. Thus the tissues are not bathed with arterial blood sufficiently long to be nourished properly. Obstructing a large vein may prevent this rapid passage of arterial blood and so equalize the circulation and improve the condition of the limb. In this way may be explained some of the reported improvements that have followed reversal of the circulation in a limb, particularly after the end-to-end method.

When doing a lateral anastomosis of artery and vein, Bernheim and Stone (*ANNALS OF SURGERY*, October, 1911) recommend making the opening in the vessels by transfixing them with a cataract knife and cutting from within out about one-third of the circumference. The vessels are then cleaned with either normal salt or Ringer's solution, anointed with liquid vaseline, and united by a continuous suture of fine silk.

Bernheim and Boegtlin (*Bulletin of Johns Hopkins Hospital*, February, 1912, page 33) discuss the question of whether an Eck fistula is compatible with life and describe a new method of making this fistula. The portal vein and vena cava are first sewed together with a small curved needle and silk, using a continuous suture and No. 3 curved

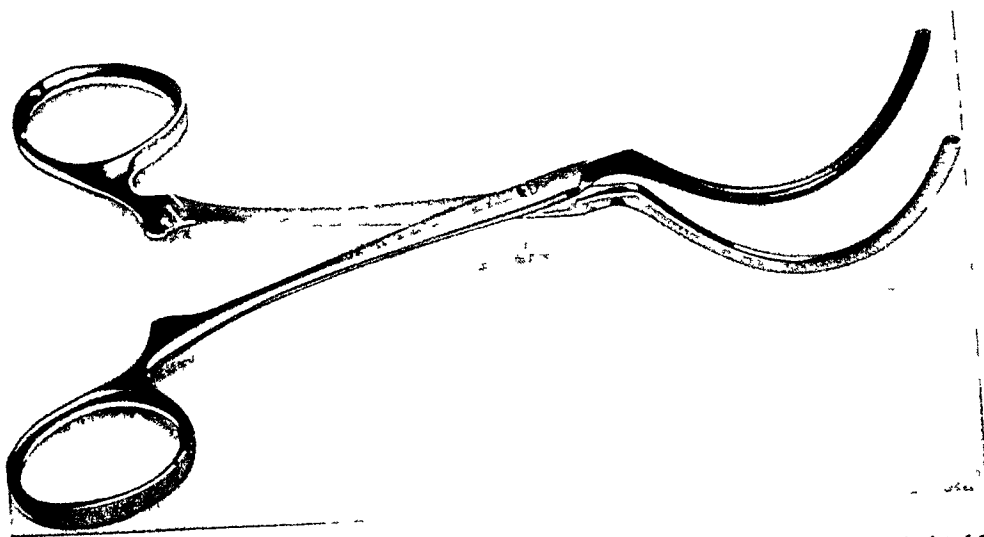


FIG 1—Forceps for lateral blood-vessel suturing. They are made with very light blades which can be clamped on the skin of the forearm without pain. The handles lie in the axis of a line drawn from the tip to the heel of the blades. In this way the handles will lie flat even in a deep wound and be out of the operator's way. In order still further to prevent injury to the intima, the blades may be covered with soft rubber tubing.

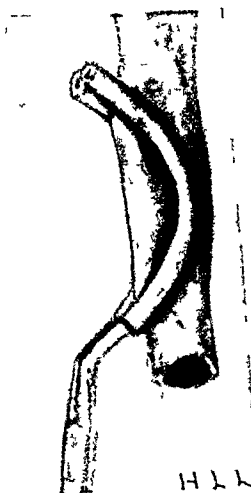


FIG 2—One forceps is shown covered with rubber and grasping the vessel preparatory to making a lateral anastomosis. If it is deemed wise to occlude all of the vessel only a portion of it can be caught.

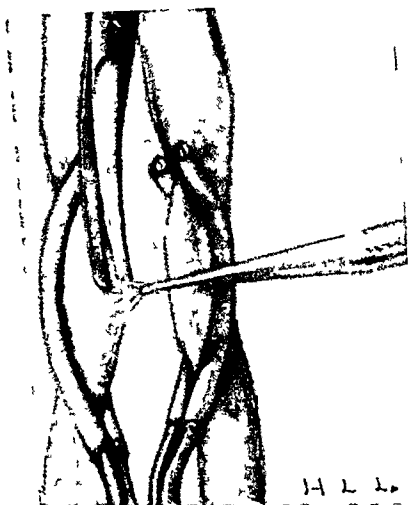


FIG 3—The two vessels to be anastomosed have been clamped. The adventitia is being lifted and cut away.

vessels for lateral suture One was Joani's clamp (*Keen's Surgery*, vol 5, page 128) I have never seen this instrument but from the illustration the points appear frail and the handles are at such an angle to the blades as to interfere with suturing The forceps of Stewart (*Journal A M A*, August 20, 1910), the jaws of which consist of large ovals, could not be used in arteriovenous aneurism The instrument of Jeger (presented at German Surgical Congress, 1912), a diminutive Roosevelt gastro-enterostomy clamp, has straight blades and the middle blade is objectionable It was devised for making an Eck fistula

After experimentation and several changes, a model was devised that seems to obviate the objections of the other instruments (Fig 1) These forceps for lateral suture are five inches long, have thin, well-tempered curved blades with longitudinal grooves, and handles that extend in the axis of an imaginary line drawn from the tip to the heel of the blades The blades fit accurately but are soft enough to be clamped on the skin of the forearm without pain They can hardly injure the intima, but to make this even surer, soft, pure rubber tubing is slipped over them The tubing should not be too close to either the heel or the tip of the blades, as this might interfere with the pressure in the middle of the blades and so cause leakage Such forceps can be used for suturing lateral wounds of large blood-vessels without entirely obstructing the blood-current In making an Eck fistula, the axis of the handles makes it possible for the handles to lie flat in the abdomen and so be out of the way These forceps can be used where no tourniquet can be applied, as on the iliac vessels, or in operations on an arteriovenous aneurism where hæmostasis is not satisfactory by other means Even where hæmostasis is complete, they serve to steady the walls of the blood-vessel while sutures are inserted and lessen the amount of intima exposed, so preventing it from drying

These forceps have other uses than for lateral anastomosis, or the cure of arteriovenous aneurism For instance, they can be employed for hæmostatic forceps instead of the Crile clamp, acting in the same manner as the forceps of Matas, which are designed for temporary occlusion of the vessel As the blades are very soft, they can be very quickly applied and locked without fear of injury to the intima I have also used the forceps satisfactorily in a gastro-enterostomy in an infant four weeks old when an operation was necessary on account of pyloric stenosis

In lateral anastomosis of blood-vessels, whether uniting veins as in Eck fistula, or an artery to a vein, the general principles of blood-vessel suturing should be observed Asepsis should be rigid, hæmostasis complete, the tissues should be handled gently, the adventitia should be

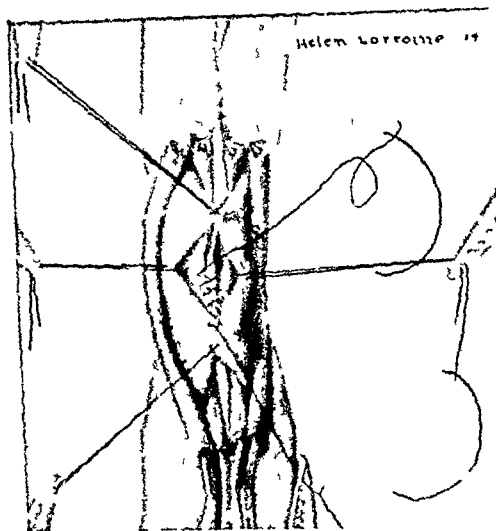


FIG 7—Suturing has been begun by using a very fine curved needle and black silk. It is started by going from without inward on one side and from within outward on the other side. The thread is then tied which leaves the knot outside of the lumen. The end of the thread is caught in a clamp. The needle is then thrust through the artery near the knot and suturing begins as an overhand continuous stitch. It is important to have the knot placed in the angle of the incision.

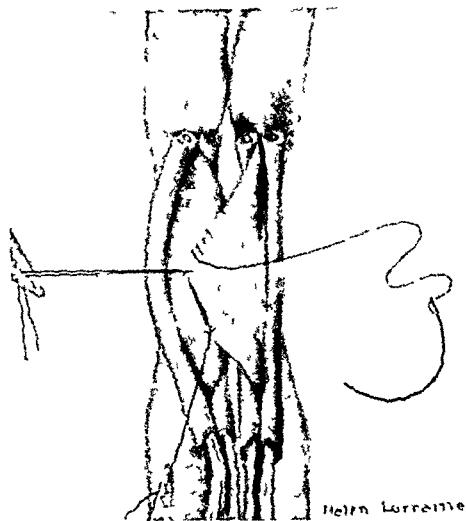


FIG 8—The suturing is continued and after the upper angle is reached, the tractor suture on the left is removed and the needle and tractor suture on the right thrust through the margin of the left vessel. This is tied and when lifted up brings the sides accurately together and renders the suturing easier. After the thread has reached its original starting point, it should be carried about one stitch beyond the knot and tied snugly to the end that was clamped in forceps.

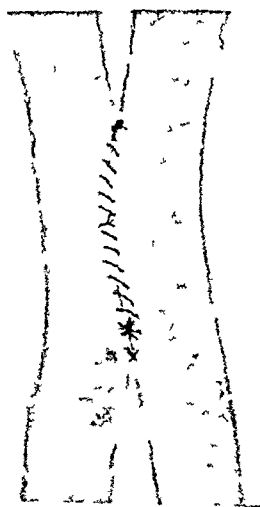


FIG 9—The lateral anastomosis is completed. The technique is practically the same for an Eck fistula or an arteriovenous anastomosis except as shown in Figs. 4 and 5.

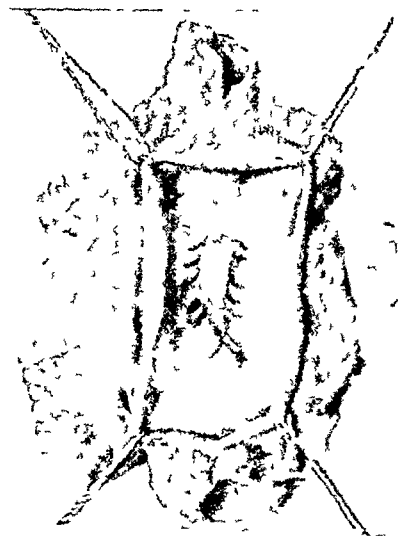


FIG 10—Drawing of a specimen of an Eck fistula in a dog 6 days after the operation. There is no thrombosis.

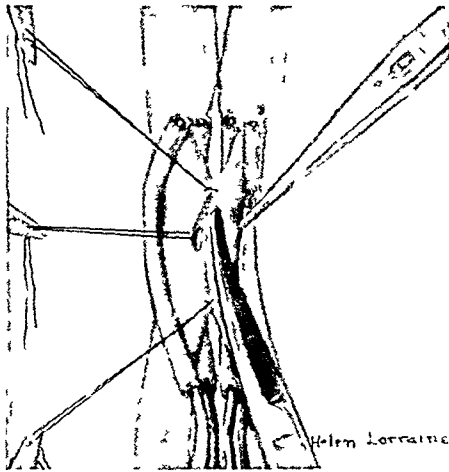


FIG 4—The openings in the two vessels are being made. The method illustrated in this drawing is that which should be employed in an Eck fistula. A small point of the vein is caught with the fine thumb forceps, lifted up and the apex cut away with scissors parallel with the vessel. This is done on each side after the two guy or stay sutures have fastened the veins together near the end of the proposed incision. After a small hole has been cut, a tractor suture is inserted in the left wall of the vena cava and is clamped with forceps but is not tied. Another suture is inserted in the right (operator's right) wall of the portal vein by passing the needle from without inward. The needle is left attached but the suture is not tied. By pulling on these sutures the small openings are exposed and can be enlarged as a slit with scissors. If a transverse opening is made here the ends of the transverse incision will retract in the deep wound.

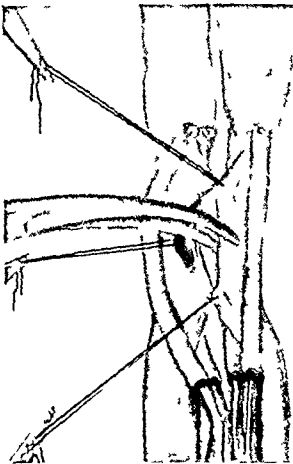


FIG 5—This shows a transverse cut which is the method used in suturing an artery in making a lateral anastomosis for reversing the circulation. The transverse cut in the artery retracts into an oval opening. A similar opening is made in the vein. The tractor sutures are inserted as described in Fig 4.

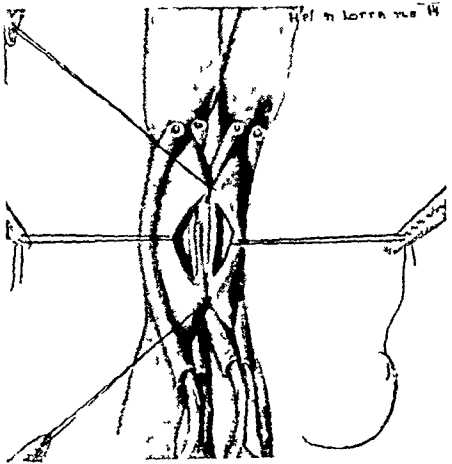


FIG 6—The two stay sutures and two tractor sutures are inserted and the openings are ready for suturing.

LATERAL ANASTOMOSIS OF BLOOD-VESSELS

removed, and after the intima is exposed the operation should be completed as quickly as possible by uniting intima accurately to intima leaving but little foreign substance or suture material exposed in the lumen

The vessels are exposed as fully as possible and are mobilized. It is not necessary to dissect both vessels entirely free from their beds, if they are close together. The adventitia over the parts of the vessel to be incised is dissected off and the lateral clamps described applied, catching a deep hold on the vessel wall (Figs 2 and 3). Both are applied in the same direction. It is better, if possible, for the vessel to be stripped of blood while placing the clamps. After both clamps are fastened, the vessels are anchored together with two stay sutures of fine silk sterilized in vaseline and placed at a little distance from the two extremities of the proposed anastomotic opening. The ends should be left long and the vessels manipulated by these stay sutures and not by the handles of the clamps, which might slip or pull off with too much traction. An incision is then made into the vessels. This is done when an artery and vein are united by incising the artery transversely for about one-third of its diameter with sharp scissors (Fig 5). The wound retracts leaving an oval opening, and is smeared with white vaseline by dipping a finger of the left hand in vaseline and anointing the wounded vessel. The opening in the vein is made in a similar manner and should be slightly larger than the opening in the artery. A fine thumb forceps, or "frog" forceps, holds the vessel wall while it is being incised and enables the surgeon to make the opening more accurately. A tractor suture of fine silk sterilized in vaseline is placed in the left margin of the opening in the left vessel. This is not tied but clamped with mosquito forceps. A similar tractor suture is placed in the right margin of the right vessel, but the needle end is left attached and the suture is placed from without inward (Fig 6). The sewing is now begun with a small curved arterial needle (or No 3 French intestinal needle) and fine silk sterilized in vaseline, starting from the angle of the incision nearest the handle of the forceps. The needle is thrust through the wall of the vessel at the angle, going from without inward on one side and from within out on the other. The thread is then tied, holding the ends of the thread taut while running down the second knot to prevent slipping. This leaves the knot outside the lumen. The short end is clamped with mosquito forceps. The needle is again thrust through the blood-vessel wall near the knot, and a continuous overhand suture is applied, uniting the intima accurately (Fig 7). This can be easily done, using a mosquito forceps for a



FIG 11 —Lateral anastomosis between the carotid artery and external jugular vein in a dog. Note the clear opening and just below the opening a valve in the vein. Specimen removed twenty one days after operation.



FIG 12 —This shows how the clamps for lateral suture may be applied on an arteriovenous aneurism without the necessity of fully dissecting out the aneurism.

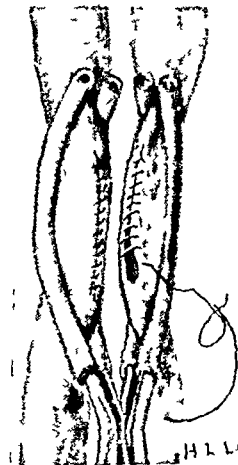


FIG 13 —The communication between the artery and vein has been divided and the vessels are being sutured. It is best to use a cobbler's stitch and fine arterial needles in the artery but if this is impossible a fine curved needle may be used.

LATERAL ANASTOMOSIS OF BLOOD-VESSELS

trition of the limb is seriously affected, or if the heart shows signs of failing under the extra strain on the venous side, operation should be attempted. In a heart that is already incompetent, pressure upon the aorta for temporary hæmostasis, or ligation of a large vessel, might result disastrously, and the safer method under such circumstances would be to reëstablish the circulation in both the artery and vein. Here it is advisable to dissect both vessels carefully, exposing the lesion, and then to grasp the artery and the vein with the forceps for lateral suture of blood-vessels (Fig 1). After grasping the artery and vein their communication is severed, the edges of the wound in the vessels properly trimmed, and with a cobbler's stitch in straight arterial needles or an overhand stitch in a curved needle, the opening in the artery and then in the vein is closed (Figs 12 and 13). If possible without too much constriction of the lumen, a continuous reinforcing stitch over this may also be used. As the artery is often dilated on the cardiac side of an arteriovenous aneurism and constricted distally, it would be advisable to diminish the pressure from the enlarged artery by partially closing its lumen with a surrounding strip of fascia, a loosely applied aluminum band, or infolding the artery by sutures as suggested by Matas and Allen.

needle holder if necessary, and pulling on the tractor and stay sutures as indicated to expose the margins of the vessel wound. At the other angle care is taken to place the sutures closely, for leakage is likely to occur here. After this angle has been sutured, the left tractor suture is removed and the needle on the right tractor suture is then thrust through the wall where the left tractor suture was, and this suture is then tied (Fig 8). The excess of vaseline is squeezed out, the tractor suture is lifted up so as to evert the intima, and the sewing is continued as an overhand stitch. When the original knot in the continuous suture is reached, about one stitch is taken beyond it and the thread tied to the end that was left clamped in mosquito forceps (Fig 9). The clamp from the vein is first slowly removed and the line of suturing slightly compressed with dry gauze. After a minute the arterial clamp is slowly relaxed and then removed if no markedly spurting point occurs. If it does, the clamp is re-applied and a suture placed at the spurting point. A ligature is tied on the cardiac side of the vein to prevent the blood being immediately returned to the heart.

In making an Eck fistula this same technic is followed, except in incising the blood-vessels it was found that a transverse incision was not practical in large, thin vessels in such a deep wound, for it was difficult to suture the deepest portion of the transverse incisions. The opening in the veins is made as follows. A very small bite of the vena cava about the middle of the proposed incision is caught with the "frog" forceps or with mosquito forceps and pulled up to form a cone whose apex grasped in the forceps is cut off with curved scissors (Fig 4). A tractor suture is inserted in the outer wall of this small opening in a similar manner as in arteriovenous anastomosis. The same procedure is carried out on the portal vein and a tractor suture inserted from without inward and the needle left attached. These openings are then enlarged longitudinally as far as desired. The rest of the technic is followed exactly as described for arteriovenous anastomosis. It is possible, however, to use successfully a coarser needle and thread in Eck fistula than in arteriovenous anastomosis, as the pressure is very low in the large veins.

In operations upon arteriovenous aneurism, if a tourniquet can be applied and complete hæmostasis obtained, the division of the communication and suturing the vessels are often simple, but even in such instances the use of these forceps would probably make the suturing easier.

When it is impossible or impracticable to secure complete hæmostasis by a tourniquet the problem is much more difficult. If the nu-

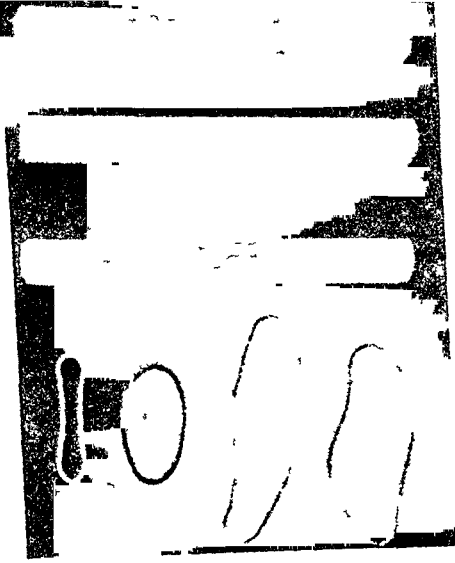


FIG 1 —Elements used in tongue-depressor clamp

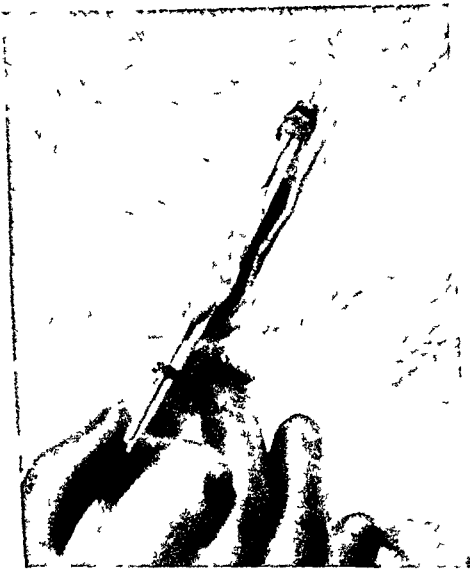


FIG 2 —Clamp applied to intestine

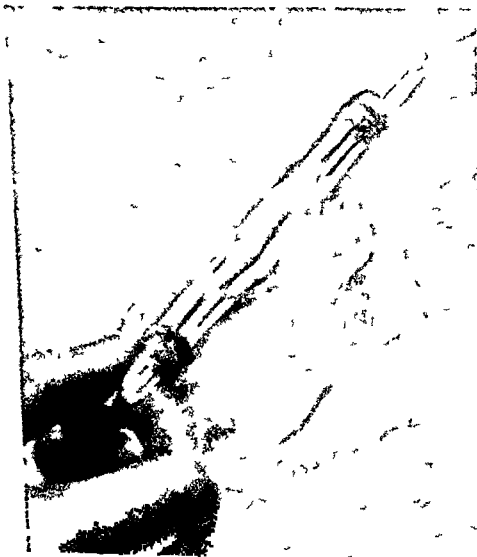


FIG 3 —Both corps clamped and clamps approximated and held by rubber bands

THE "TONGUE-DEPRESSOR" GASTRO-ENTEROSTOMY CLAMP

BY CHARLES L GIBSON

OF NEW YORK

SURGEON TO THE NEW YORK HOSPITAL

THE accompanying illustrations (Figs 1, 2, and 3) clearly indicate the make-up of the clamp for gastric and intestinal anastomoses. Three small pieces of wood, the ordinary wooden tongue-depressors, are bound together by any suitable method, such as a strong artery clamp, or, if more convenient, a sterile rubber band. It is needless to point out that the tongue depressors might be replaced by strips of cigar boxes.

This clamp is presented, not as a freak or for its possible cheapness, but because in my hands, both in experimental and clinical work, it has proven much more satisfactory than the Roosevelt, Bartlett and other clamps used for this purpose. I have found it particularly satisfactory in doing a gastro-enterostomy, when it is desired to release the clamp in putting in the last mucous muscular suture and the final peritoneal suture. Removing the rubber band allowed the tongue depressors to fall apart without further manipulation. By this method injury to the viscera is less likely to be produced.

Two gastro-enterostomies and one entero-anastomosis have been successfully done with the aid of these clamps. The first case was that of a man, twenty-nine years, with symptoms of gastric ulcer. Upon operation, which was done November 19, 1914, the stomach was found to be markedly distended, with an indurated ulcer, juxtapyloric, on the lesser curvature, and some stenosis. A gastro-enterostomy with the tongue-depressor clamps was successfully done.

The second case was that of a man, twenty-two years old, with a saddle-shaped ulcer located close to the pylorus. A posterior gastro-enterostomy was done with the tongue-depressor clamps.

The third case was that of a man, twenty-two years old, with tuberculosis of the intestines, particularly involving the mesenteric nodes, with an incomplete obstruction of a coil of jejunum resulting from diffuse adhesions. A successful entero-anastomosis was done with the aid of the tongue-depressor clamps.

THE PREVENTION OF KELOIDS IN SCARS BY THE UNDER-LINING OF INCISIONS WITH STRIPS OF FASCIA LATA*

BY LEONARD FREEMAN, M D.
OF DENVER, COLO

THE free transplantation of fascia lata has been employed recently for a variety of purposes—in operations for hernia, to close defects in the abdominal wall, the pleura, the dura, the bladder, the intestinal tract, the trachea and the larynx, in nephro- and gastropexy, for elevation of the corner of the mouth in facial paralysis and of the eyelid in ptosis, for the reinforcement of suture-lines in operations upon the intestines, for closure of the pylorus in gastro-enterostomy, for the repair of tendons and the formation of new ones, in the mobilization of ankylosed joints, etc

It is well adapted for all these purposes because of its strength and non-elasticity, its remarkable tendency to heal in, even, at times, in the presence of infection, and because it does not undergo absorption, but remains unchanged within the tissues. The material is abundant and easily obtained. It may be removed from the thigh in narrow strips or in large areas, with or without closure of the resulting gap in the fascia, there being little danger of subsequent injury to the functions of the extremity.

To the uses already reported I desire to add a new one which is perhaps of some importance.

One of the disagreeable things which may follow a surgical operation and detract much from an otherwise satisfactory result is hypertrophy of the cicatrix—a so-called “false keloid.” The scar becomes thick, elevated and red, and if in an exposed position it is a source of mortification to both surgeon and patient.

No reliable method has been devised for the removal of these keloids. When excised they almost invariably return, owing to the continuation of the causes which produced them, and the injection of thiosinamin and other substances is equally unsatisfactory.

The hypertrophy seems mainly due to tension upon the scar, and hence it is seen in connection with longitudinal rather than with cross

* This method was described in a discussion before the International Surgical Society, New York, April 14, 1914.

THE PREVENTION OF KELOIDS IN SCARS

false keloid There is absolutely no pull upon the new scar, which is soft and freely movable upon the surface of the underlying graft There is little tendency to hypertrophy or redness, except near the clavicle, to which the fascial strip unfortunately did not quite extend In other words, the new scar is relatively inconspicuous and "normal," much to the satisfaction of the patient

It is interesting to note, however, that the smaller, posterior scar, the "control experiment," which was not underlined, has become markedly red and elevated, in spite of its being relieved from a certain amount of strain by the anterior fascial graft, while the longitudinal scar upon the thigh from which the graft was obtained is fiery red and almost as broad and thick as one's little finger

It must not be lost sight of, however, that a part of the satisfactory outcome may be due to the mere underlining of the incision with a layer of tissue corresponding to a smooth, firm, intact deep fascia, and not altogether to the relief from longitudinal strain, but however this may be, the value of the method remains the same.

A second case upon which I operated in a similar manner was that of a young woman from whose neck a mass of tuberculous glands had been excised, leaving a long, red, hypertrophied scar extending from the mastoid downward and inward almost to the larynx The disfigurement was not so great as in the preceding case, but it was sufficient to justify an energetic attempt at its removal The result, at the end of 4 months, is eminently satisfactory, the scar being small, soft, not red, and freely movable over the fascial graft

There is theoretical ground, at least, for assuming that the horrible deformities due to the hypertrophy and contraction of burns, especially about the neck, may, in appropriate cases, be relieved by the intelligent use of fascial grafts It does not seem likely that the method can be of much, if any, value with true keloids

incisions Wounds about the neck, the abdomen or the joints which run at right angles to the line of normal tension are seldom if ever followed by much hypertrophy, while those parallel to the line of tension are frequently affected, as may be observed in the axilla after operations for cancer of the breast and about the neck following various surgical procedures Hypertrophy is particularly apt to occur in tuberculous patients, owing, perhaps, to substances circulating in the blood, or present in the skin, which predispose to the excessive formation of fibrous tissue Hence conspicuous and deforming scars often follow operations for tuberculous glands of the neck

Some months ago a young and handsome woman consulted me regarding the removal of a disfiguring scar resulting from an operation for tuberculous lymph-nodes of the left side of the neck It extended from the mastoid to the centre of the clavicle and was as wide and as thick as one's thumb It was fiery red and formed a conspicuous and mortifying deformity, as it stretched across the neck like a great "flying buttress"

Knowing that excision of the cicatrix would be followed inevitably by a prompt recurrence, as had been my experience on previous occasions, it occurred to me that if tension upon the new scar could be eliminated, it would be placed under the same conditions as a cross-incision, and reappearance of the hypertrophy might be prevented

Hence, with this idea in view, a strip of fascia lata was procured from the thigh, long enough to reach from the mastoid almost to the clavicle, with the head in the median position, and about as broad as one's finger After thoroughly extirpating the scar and undermining the edges of the wound, the strip was spread lengthwise beneath the incision It was then fastened to the under surface of the skin and fascia on one side, and to the deeper tissues on the other side, with a few sutures of fine catgut, thus permitting the union above it of the integument and cervical fascia without danger of displacement Primary union was obtained

Posterior to the longer scar described above was a much shorter one, which was also hypertrophied and red This was likewise excised, but for various reasons was not underlined with fascia lata, although the deep fascia was carefully sutured Hence this second scar became a sort of "control experiment"

At the end of over 12 months the results of the procedure are as follows When an attempt is made to incline the head to the opposite side, the movement is checked by the strip of fascia lata, which stands out plainly beneath the skin This does not inconvenience the patient, because the same check was produced to even a greater extent by the



FIG 1—Case I Five weeks after operation



FIG 2—Case II Before operation



FIG 3—Case II End result



FIG 4—Case V Before operation

RUPTURE OF THE BICEPS FLEXOR CUBITI *

WITH A REPORT OF EIGHT CASES

BY EMORY G ALEXANDER, M D

OF PHILADELPHIA

ASSOCIATE SURGEON TO THE EPISCOPAL HOSPITAL

RUPTURE of the biceps muscle or its tendon is a rather rare accident. It may be of interest to the Academy, therefore, to present eight of these cases, especially as five were operated upon and the exact location of the rupture was determined. Literature reviewed on the subject cites only 74 cases, 5 of which were operated upon.

CASE I—M C, aged twenty-six years, white, male, laborer. Admitted to the Episcopal Hospital January 9, 1914.

History—On the day of admission, while at work cleaning out an endless chain elevator shaft, the elevator suddenly started and one of the buckets caught his right arm, crushing it against the side of the shaft. He was held in this position for forty-five minutes before being liberated. The shock following the accident was so great that it was necessary to remove him to the hospital in the ambulance. On admission to the hospital the patient was in a state of severe shock. He was unable to raise the right arm or flex the forearm.

Examination—Showed a contused wound of the right chest wall and right arm. No bones were broken. The right arm anteriorly from the shoulder to the elbow was markedly swollen and ecchymosed. On deep palpation over the upper part of the biceps, where the swelling was greatest, a distinct furrow could be felt. This furrow was about the width of the index finger. The width of the furrow could be increased by extending the forearm. On account of the great swelling of the arm no bulging appeared at any point over the biceps on extending or flexing the forearm. A diagnosis of rupture of the belly of the biceps was made and an operation advised. On account of the bruised condition of the tissues the operation was postponed for several days.

On January 11, 1914, under ether anæsthesia, the patient was operated upon and a rupture of the belly of the short head and a partial rupture of the belly of the long head of the biceps were found. The ends of the muscles were properly approximated.

* Read before the Philadelphia Academy of Surgery, January 4, 1915

RUPTURE OF THE BICEPS FLEXOR CUBITI

and sutured with twenty-day chromic catgut. The arm was dressed with the forearm in flexion, so as to relieve any strain on the sutured muscle. Primary union followed. Firm union took place between the ruptured ends. This could readily be determined by grasping the biceps over the seat of rupture and flexing and extending the forearm. On account of the marked atrophy of the humeral group of muscles which followed the accident, the return of power in the patient's arm was very slow, and massage and electrical treatment were given. At the time of his discharge from the hospital the biceps still showed marked atrophy, but the patient had good use of the arm and forearm. The usefulness of the arm has steadily improved and the patient is now able to follow his usual occupation.

CASE II—F L, aged fifty-three years, white, male, cloth finisher. Admitted to the Episcopal Hospital on January 16, 1914.

History—In 1910, while putting a large belt on a fly-wheel, he lost his balance and fell, striking his right shoulder and arm against a machine. When he struck the machine he felt something give way in his arm, experienced a sharp pain at this point, and heard "a sound like the report of a revolver." Immediately his arm became swollen, "black and blue," and a "lump" appeared at the lower part of the arm over the belly of the biceps. For a short time following the accident he was unable to use the arm. He consulted a physician for the injury, who prescribed a liniment. No fixation apparatus was applied. The ecchymosis and swelling disappeared in one or two weeks, but the "lump" remained. He continued working at his trade but his arm was so weak that he finally gave up his position and sought an easier one. Since the accident he has been able to do only light work, as his forearm under muscular effort will often give way. The weakened condition of the arm and forearm has persisted, although he has been treated with electricity, massage, etc. He has never had rheumatism, gout, typhoid fever nor lues.

Examination—His right arm, when either the forearm was flexed or extended, showed a marked bulging of the belly of the biceps. The bulging was greatest when the forearm was forcibly flexed to a right angle and the flexion strongly resisted. The entire biceps muscle was soft and flabby. Above the belly of the biceps, which terminated very abruptly, it was impossible to feel the tendon of the long head. There was no difference in the power of flexion of the forearm, whether it were supinated or pronated. A diagnosis of rupture of the tendon of the long head of the biceps was made. As four years had elapsed since the accident it was with some hesitancy that an operation was advised, but as

RUPTURE OF THE BICEPS FLEXOR CUBITI

This patient, I feel sure, ruptured his biceps muscle much longer ago than six weeks before the operation. The interesting point is that although he had quite a bulging of the muscle he had never suspected any trouble.

CASE IV—G C, aged fifty-three years, white, male, machinist. Admitted to the Episcopal Hospital April 27, 1914.

History—Six months before admission, while working on a lace curtain machine, he attempted to stop the wheel by catching it as it revolved. He succeeded in stopping the wheel, but it gave his shoulder quite a "wrench" and he felt something "give way" in his arm and heard "something snap." On flexing the arm he noticed a bulging over the biceps. Although he noticed that his arm was much weaker the accident did not completely disable him. The weakness was progressive and for this reason he came to the hospital. There was no history of gout, rheumatism, typhoid fever or lues.

Examination—Symptoms similar to Cases II and III. Huter's sign was present. (Huter calls attention to the fact that flexion of the forearm in pronation when the biceps is tense is more forcible than when the forearm is supinated and the biceps is relaxed.) On April 20, 1914, under ether anæsthesia, the patient was operated upon and a rupture of the tendon of the long head at its junction with the belly found. The tendon was readily found, but it appeared more as a small fibrous cord than as a tendon. On account of the weakened condition of the tendon, I did not think it advisable to suture it to the muscle, but instead, sutured the belly of the long head to the tendon of the short head. The case was treated as the preceding. Primary union followed. The patient has a very satisfactory result. There is very little bulging of the muscle on forced flexion of the forearm and the arm and forearm are much stronger than before the operation.

CASE V—W S, aged forty-one, white, male, laborer. Admitted to the Episcopal Hospital on December 9, 1914.

History—On the morning of admission to the hospital, while lifting a bag of coffee, he was suddenly seized with pain and heard something snap in his left arm. He said it felt as if "somebody had hit him with a club." As he was unable to use his right arm after the accident, he came immediately to the hospital. There was no history of typhoid fever, gout or lues, but an indefinite history of a mild attack of rheumatism in the left shoulder.

Symptoms were those of a rupture of the long head of the biceps. No hæmatoma or other signs of recent injury were present. Huter's sign was not present.

The patient refused to be operated upon and left the hospital the same day that he applied for treatment.

the patient was practically incapacitated it was hoped that an operation might better his condition

On January 19, 1914, under ether anæsthesia, he was operated upon. An old rupture of the tendon of the long head at its junction with the belly was found and fibrous union had taken place between the tendon and the muscle. This cicatricial tissue, about one and one-half inches, was excised. The end of the tendon was split for about three-quarters of an inch and the muscle brought in between the two ends of the split tendon and sutured with twenty-day chromic gut. The arm and forearm were dressed as in Case I. Primary union followed.

The case progressed most favorably and the patient now states that he has been much benefited by the operation. A slight bulging still persists at the site of the old rupture.

CASE III —P McC, aged sixty-one years, white, male, punch helper. Admitted to the Episcopal Hospital on March 21, 1914.

History —The patient came to the Medical Dispensary of the hospital on account of pain (rheumatism) in his right shoulder and weakness of his arm. In examining him the physicians found that he had, besides a chronic articular rheumatism, a rupture of the biceps muscle. Although the bulging was very great the patient had never noticed it. The patient stated that about six weeks before he came to the dispensary for treatment, while at work in a punch shed, he tripped and fell, striking his right shoulder. The injury caused him some pain and was followed by some stiffness of the shoulder. Since the accident he has noticed that his arm and forearm are weaker and that the weakness is increasing.

Examination —Symptoms similar to Case II, the only difference was that in this case the bulging was greater and the muscle more flabby. Huter's sign was not present.

On March 26, 1914, the patient was operated upon and a rupture of the tendon of the long head at its junction with the belly found. I was unable to find the tendon of the long head although I searched for it up to the bicipital groove. I did find a fibrous sheath, which I took to be the sheath of the tendon, there was, however, no tendon within it. As the sheath was not strong enough to suture the muscle to, the stump of the belly of the long head was sutured to the tendon of the short head.

The patient's arm was treated as in Case II. Primary union followed. Anatomically, the patient does not appear to be very much benefited, as he still has quite a bulging of the muscle. Functionally, he has been greatly improved and now says he is sure he is able to return to his former work, which he had had to give up on account of the weakness of his arm.

RUPTURE OF THE BICEPS FLEXOR CUBITI

Unfortunately, in the above two cases, no note was made as to whether the patients were right- or left-handed

Loos¹ reports 66 cases of rupture of the biceps, 44 of which were of the muscle, and 18 of the tendon. Four of these were his own

PETIT,¹ according to Loos, collected 83 cases In this series the point of rupture was as follows Muscle 21, belly of the long head 9, tendon of the long head 43, at junction of belly of the long head and tendon 7, the tendon of insertion 3. I failed to find an article on the subject by Petit, so was unable to verify the statistics as given by Loos

WIFSMANN² reviews the literature on this subject and reports a case of rupture of the tendon of insertion caused by the lifting of a table He operated upon the case and obtained a successful result

DAVIS³ reports 4 cases, as follows Rupture of the tendon of the long head 3, rupture of the tendon of insertion 1.

CASTRET⁴ reports a case of rupture of the belly of the biceps due to slight muscular contraction The case was treated by electricity

HOLLOS⁵ reports "two cases of biceps rupture by paralysis" I have been unable to find his article

KEEN⁶ reports a case of rupture of the tendon of the long head and also one of DaCosta's, of a tearing off of the long head from the margin of the glenoid cavity Both of these cases were successfully operated upon

GERSTER⁷ reports a case of laceration of the long head of the biceps due to a fall down stairs The case was successfully treated with a sling

In 64 of the cases reported, in which the histories were given in sufficient detail to locate the lesion, 16 occurred in the tendon, 44 in the muscle, and 6 at the junction of the tendon and the muscle As only 5 of the cases reported were operated upon the exact site of the rupture in the others could not be ascertained

Davis³ believes that true rupture of the tendon is rare and "when a tendon does rupture it is very likely to have been diseased" In Case IV of this series it appeared as if the tendon was either diseased or malformed.

From the cases reported it appears that rupture may take place through the belly of the long or short head, through the belly of the muscle proper, at the transition point of the belly and tendon, through the tendon of the long head or the tendon of insertion, and even as in DaCosta's case, at the origin of the tendon of the long head.

Of the cases reported, 4 have been the result of muscular effort alone Only 2 cases are reported in which the accident occurred in women Only 2 cases are reported of rupture of the belly of the short head, one of these was due to direct injury, a threshing machine accident, in which the belly of the short head and the tendon of the long head were both injured, an accident very similar to Case I of

This patient was operated upon one week after the accident by Dr G G Davis at the University Hospital. The operation disclosed the tendon of the long head relaxed. A rupture had taken place at some point between its origin and the bicipital groove. The tendon was not pulled out of the groove, but the slack portion was taken up and the tendon sutured to the tendon of the short head.

CASE VI—R McF, aged sixty years, white, male, fish dealer. Admitted to the Episcopal Hospital on December 15, 1914.

History—Three months before admission, while attempting to lift a barrel of fish, he was suddenly seized with a severe pain in his left arm. He dropped the barrel and rested the arm for a few minutes until the pain subsided. The night following the injury he suffered greatly with pain in his arm, forearm and fingers. Since the accident, on account of the weakness of his arm, he has been unable to do heavy work. He says that his left arm frequently "goes to sleep." No history of typhoid fever, rheumatism, gout or lues, but is a heavy whiskey drinker.

Examination—Symptoms similar to Cases II to V inclusive. Huter's sign not present. The muscle showed quite a bulging and was very flabby. Blood-pressure 180 systolic. No symptoms of nerve involvement.

Diagnosis—Rupture of the long head of the biceps, probably at the junction of the tendon and muscle. As the patient was in very poor physical condition no operation was advised.

Besides the six cases reported above, two other cases have been treated this year in the Medical Dispensary of the Episcopal Hospital.

CASE VII—Wm M, aged eighty-four years, white, male, insurance agent. This case came to the Dispensary on account of a traumatic arthritis of the left knee. In the examination of the patient it was discovered that he had a rupture of the long head of the biceps muscle of the left arm. The probable seat of rupture was at the junction of the muscle and tendon. The Dispensary notes state "No symptoms at time of rupture or afterwards, no history of rheumatism, typhoid fever or lues."

CASE VIII—Wm L, aged fifty years, white, carpenter. The patient was admitted to the Dispensary for treatment for chronic endocarditis and myocarditis. He was treated six years ago in the Episcopal Hospital for a severe attack of acute articular rheumatism. The lesion in this case was of the long head of the biceps of the left arm. The rupture, as in Case VII, was probably at the transition point between tendon and muscle. This case, as the preceding, had "no symptoms at time of rupture or afterwards."

RUPTURE OF THE BICEPS FLEXOR CUBITI

to feel the tendon above that point, all point to rupture of the muscle or tendon. In rupture of the tendon or muscle of the long head the short head stands out prominently, and to its outer side, where the long head and tendon should be, a sulcus running upward and slightly inward is found.

Huter's symptom was present in only one of this series. It was not tried for in Case I.

The treatment in the great majority of cases has been either none at all, or bandage, sling, electricity, etc. No doubt many cases have been operated upon. I have only been able to find, however, 5 cases treated in this manner.

VON HOCHSTETTER⁵ reports a case of a man forty-six years of age, who ruptured the tendon of the long head at its junction with the belly. This case was operated upon two months after the injury. The tendon was sutured to the belly with silk. Result successful.

BAZY⁶ reports a man, aged forty years, who ruptured the tendon of the long head at its point of origin. He operated upon this case, resected the tendon, and sutured the stump to the tendon of the short head. Result successful.

KEEN⁷ reports a case of a man, aged fifty-four years, who ruptured the tendon of the long head. The tendon was sutured with twenty-day chromic gut. Result successful.

DACOSTA,⁸ reported by Keen, operated upon a man, aged fifty-two years, who in lifting a bucket tore the tendon of the long head away from its point of origin. In this case the upper portion of the tendon was resected and the stump was attached to the short head by splitting the latter and suturing. Result successful.

WIESMANN⁹ reports a case of rupture of the tendon of insertion, caused by lifting a table. The case was successfully operated upon.

Conservative methods of treatment have given satisfactory results in a few isolated cases only. Since successful results have been gained by operation in cited cases, it is evident that the operative treatment is to be recommended.

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this series The other case occurred in an attempt to reduce a dislocated shoulder

The causes of the rupture may be either direct force, muscular contraction, or possibly an indirect force, such as a fall on the shoulder, that would throw a great strain on the long tendon, also disease or malformation might be an underlying cause

Since the great majority of the cases occur among working men, and since the right biceps is the one usually affected, it seems that muscular contraction is the most potent etiological factor

In Cases II, III and IV of this series the rupture occurred at the transitional point between tendon and muscle As tendon is stronger than muscle it is natural to believe that the rupture occurred on the muscle side of the tendon and that the underlying cause might possibly have been a myositis This cause is suggested in Case III, where the entire muscle was markedly relaxed and very flabby, although only the tendon and belly of the long head were implicated in the accident The cases reported show that rupture is most apt to occur after forty years of age As this is the period that degenerative tissue changes are most apt to make their appearance it is very probable that disease of muscle or tendon plays a very important causative part in the rupture

That rupture of the tendon or belly of the long head is more frequent than at any other site, I believe to be due to the fact that the tendon, by its position in re-inforcing the shoulder-joint, is subjected to all strains that may be thrown upon the head of the humerus Cases II and III may have occurred in this manner

The symptoms at the time of injury may be trivial, the patient noticing nothing wrong, or they may be quite severe and immediately incapacitate Swelling and ecchymosis do not always accompany the rupture

The physical findings will differ somewhat, depending on the site of the rupture If the rupture is through the belly of the muscle a furrow can be felt between the two ends, this can be widened by extending the forearm In rupture of the tendon of insertion, flexion and supination of the forearm may be interfered with and the belly of the muscle would be drawn up nearer the shoulder

In rupture of the long head, whether it be a tearing away at its point of origin, in the continuity of the tendon, at the transition point between tendon and muscle or through the belly of the long head, the symptoms are almost identical A bulging of the biceps at a point nearer the elbow than normal, a flabby condition of part or all of the muscle, an abrupt termination of the bulging above and an inability

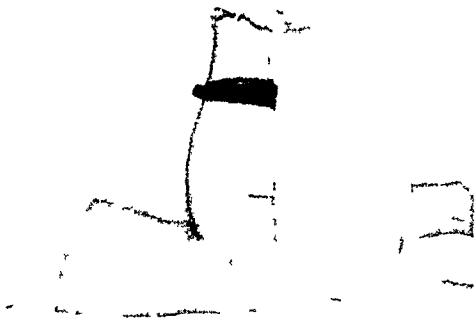
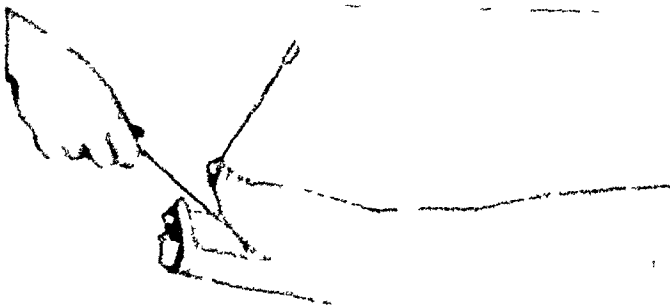
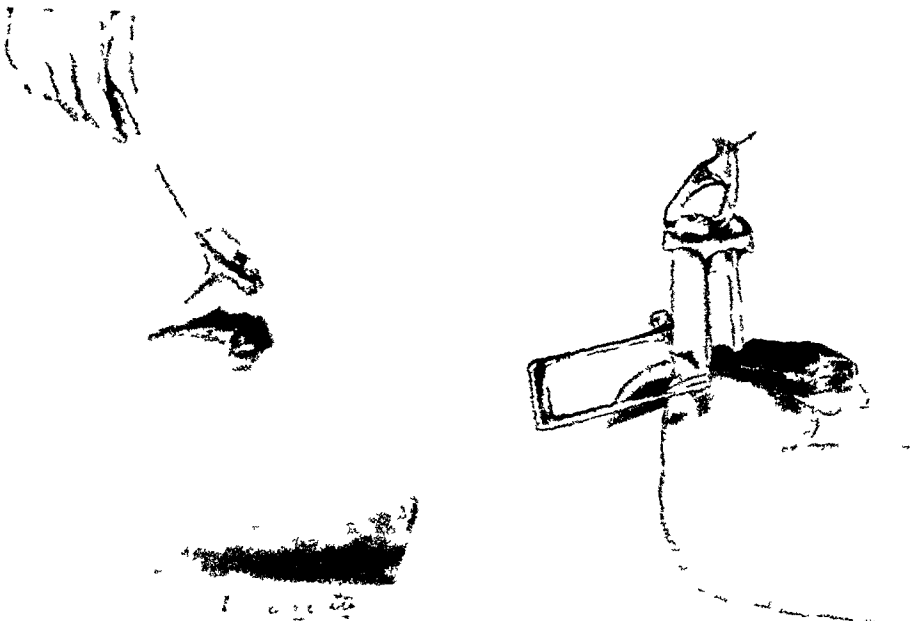


FIG 1 —The patient is in ventral decubitus
The leg to be operated upon is in flexion
Guxon's tube rolled up



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FIG 2 —Reamputation of a stump of the leg the stump in extension
while the posterior flap is being raised



R. W. M. Schmitt
J B 174

THE USEFULNESS OF VENTRAL DECUBITUS IN SOME LEG AMPUTATIONS

By RICARDO FINOCHIETTO, M D
OF BUENOS AIRES, ARGENTINA

IN amputation of the limbs position plays an important part. By manipulation of the distal end we may obtain whatever attitude it may seem best to impress upon the limb during the intervention. If position is neglected it may be difficult to execute various movements which require some energy, as, for example, in the case of amputation of the leg, the rotation of the limb or elevation of the extended leg. In cases of amputation of the forearm, attention to this precaution is easier because of the convenience with which the operator may observe the effects upon the flap which he is raising of extension or flexion, of pronation and supination. The reverse is the case in operations on the leg.

In the dorsal decubitus, the muscular mass which has to do with flexion of the leg is behind, but if the patient is placed in the ventral decubitus, these muscles become superior and one is able to control them in the flap with ease. Such a position also facilitates post-operative examination and attention.

In cases of reamputation of the stump of the leg in the position of ventral decubitus, anæsthesia is easy and well borne—the usual prejudice to the contrary notwithstanding.

The healthy limb should be allowed to fall to one side of the table so that the stump to be reamputated may be upon a superior plane. The usual antisepsis is understood to be observed.

First Step—Stump in extension, raising of the posterior flap. This step is particularly easy with the ventral decubitus. In the subcutaneous tissue the external saphenous and three or four vessels inside of the triceps are met with. The triceps is divided transversely and after section it contracts, uncovering the large vessels and nerves of the calf, which are identified and divided. The deep muscles in the interosseous space are then divided, the peroneal artery or its branches is ligated. The flap thus made is then carefully raised from the interosseous membrane to the level chosen for the section of the bone. The interosseous membrane is cut across at the level of the inferior edge

AMPUTATION OF THE LEG

of the flap and lifted out from the interosseous space after the division of its attachments to the tibia and fibula (Figs. 1 and 2)

Second Step—Stump sharply flexed, raising of the anterior flap. The assistant flexes the stump, after which the operator makes his flap, cutting the internal saphenous vein and the anterior tibial artery. The flap of the interosseous membrane already made is of marked assistance in this step, and by its preservation the artery is protected (Fig 3).

Third Step—Stump flexed to slight angle. Section of the bones. In this position the flaps with their hæmostatic forceps fall to one side or the other of the bones, facilitating not only the classic section of the bone, but also the sawing out of a piece of bone, the taking out of a periosteal collar, the scooping of the marrow, etc (Fig 4)

Fourth Step.—Toilet and Suture. The position of the stump will vary according to the method employed. Forced flexion when the longest flap is the posterior one. Extension when the anterior is the longest. Intermediate when both flaps are equal.

In a Turkish amputation the ventral decubitus is of real advantage. This kind of amputation is generally done in patients of lessened resistance and in limbs in which the circulation is abnormal, as the result of inflammation. The ventral position of the leg sensibly reduces the hemorrhage. The section of the muscles is under plain inspection. The vessels are very easily appreciated and the nerves are more apparent in the intermuscular spaces. Rapidity, very little bleeding, clean section—these are the desiderata of the Turkish operation, which are more perfectly secured by the ventral position.

In a primary amputation of the leg in its upper two-thirds ventral decubitus will afford increased facilities in the various steps of the toilet and in the application of the sutures.

In these steps two important technical details are to be observed. The first is the isolation of the infected part when the amputation is done for septic conditions. The second is the rolling up of an elastic tube (Guyon) immediately distal to the operative zone (Fig 1). Such a tube renders unnecessary the employment of forceps to the peripheral end of the veins, which forceps would be in the way at the moment of the sawing of the bones.

CONCLUSIONS—In cases of amputation through the upper two-thirds of the leg, examinations, operations and dressings should be done while the patient is in the ventral decubitus. All classes of anæsthetics can be administered and will be perfectly tolerated in that position. While in this position flaps of any form can be raised and one may

TRANSACTIONS OF THE NEW YORK SURGICAL SOCIETY

*Stated Meeting, held at the New York Academy of Medicine,
January 27, 1915*

The President, DR. FREDERIC KAMMERER, in the Chair

SUBSCAPULAR EXOSTOSIS WITH ADVENTITIOUS BURSA

DR. CLARENCE A. McWILLIAMS presented a girl, aged 18, who had come to his office in the early part of last August, complaining of dull, aching pains in the left shoulder, increased by wet weather and by use. The pain seemed to run down irregularly through the deltoid muscle, and varied much in intensity, duration and frequency. It was never a completely disabling pain. It had been present for about a year and was getting worse. Twelve years ago, following a fall, the left scapula began to become prominent. For this she wore a brace for a year, but without any benefit. The projection of the scapula backward was increasing. Just inside the posterior edge of the left scapula a swelling had appeared, varying in size from time to time, but never becoming larger than a lemon. No redness appeared over the swelling, which was very slightly tender. Motions of the shoulder itself were painless and unrestricted. The drawing of the scapula backward and forward was slightly painful, and for a year the patient had noticed on attempting this motion a grating or creaking sound.

The posterior edge of the left scapula was very prominent. There was no depression on its inner side, as would have been the case had the muscles been atrophied from paralysis. Instead, there was a fulness at the lower part of the posterior edge of the scapula. The color of the skin in this location was normal. Palpation revealed an indefinite, soft, doughy swelling of about the size of a lemon, the edges of which could not be mapped out. There seemed to be a sense of fluctuation in it. It appeared as though it ran forward beneath the scapula. The feeling was as though a cyst was present beneath the scapula. A roentgenogram was taken, which at once explained the condition. An exostosis (Fig 1) on the inner side of the lower part of the left scapula was surrounded by an adventitious bursa.

employ at will subperiosteal, periosteal, anaperiosteal and osteoplastic methods

Any method of amputation can be performed more easily while the patient is in the ventral decubitus. Equally well in the same position any condition which involves all or a greater part of the leg circumference, as ulcer, lymphangiomata, cirroid aneurisms, etc., may be examined and operated upon



FIG 1—16 exostosis

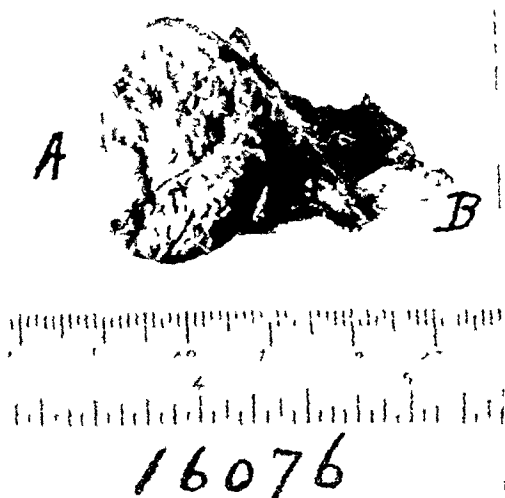


FIG 2—Exostosis after removal A free end, B pedicle with oblique cut surface



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4



FIG 4—After removal of wires on fiftieth day Shows marked periosteal growth of new bone formation.

On August 12, 1914, a transverse incision was made about $1\frac{1}{2}$ inches above the inferior spine of the scapula. A transverse incision was made in order to afford as little disfigurement as possible when a low-cut dress was worn. The trapezius fibres were separated in their direction, and the rhomboid was divided. Under its surface a thin-walled cyst was found. In the attempt to enucleate this it was ruptured. It contained serous fluid. The finger inserted, came on an exostosis which began about 1 inch from the posterior border and ran obliquely forward and inward. With a chisel it was an easy matter to divide the narrow pedicle at its base. This pedicle was much narrower at its base than at its distal extremity, as shown in Figure 2. The end of the exostosis was irregularly rough. The chest-wall on which the exostosis impinged was very rough and covered with thickened, hard connective tissue. The bursal wall was dissected out as far as possible, and, in order to obliterate any of the wall which might have been accidentally left, the space was packed with dry, sterile gauze. Separate suture of the muscular layers was made about the gauze.

Pathological examination (by Dr Whipple) revealed the following. Gross examination. There are two specimens. The first is an oval-shaped piece of bone, measuring 2.05 cm. in one diameter by 2 cm. in the other, and about 1.05 cm. in thickness. Covering it is an irregular patchy area of cartilage which is fairly smooth, with irregular edges. Considerable resistance is encountered on section. The second specimen appears to be the remains of a cyst, covering the exostosis. The cyst-wall is markedly thickened and the inner edges show a considerable amount of infiltrated blood.

Microscopic examination. The sections taken through the exuberant growth of the scapula show that the tissue is made up partly of cartilage and partly of bone. The interesting feature of the section is the picture of metaplasia occurring from cartilage to bone. Covering the cartilage in places is, apparently, a thin layer of fibrous tissue. The sections from the cyst which covered the exostosis show an unusual picture of adventitious bursa, in which the cyst-wall is made up of fairly dense fibrous tissue and the lining of modified connective-tissue cells, the innermost cells being fairly parallel to the surface of the cyst. Diagnosis. Exostosis of the scapula, with adventitious bursa.

The wound healed by primary union. Two weeks elapsed before the gauze was loose enough to be removed. Now five months after the operation the appearance of the shoulder is perfectly normal, the scapula having resumed its normal position. The grating sound has disappeared, and all motions are painless.

PERFORATED GASTRIC ULCER

PERFORATED GASTRIC ULCER FOLLOWED (TWO WEEKS) BY GASTRO-ENTEROSTOMY FOR DILATATION

DR McWILLIAMS presented a woman, 24 years of age, who was admitted at 3 P.M. on December 10, 1914, with a temperature of 101 degrees, pulse of 105, with white blood cells 31,000, polymorphonuclears, 91 per cent. She had been seized, five hours previously, while walking upstairs, with severe, agonizing, sharp pain in the epigastrium. This was located at first to an area the size of a silver dollar, but later became diffused over the upper part of the abdomen, radiating into back and shoulders. All movements in bed increased the pain. This initial pain was almost immediately followed by weakness and a feeling of faintness, with collapse and profuse cold perspiration. Her past history was that for three years she has had attacks of nausea, vomiting, and the belching of gas, which came on from two to ten hours after eating, always relieved by vomiting. Ten months ago she was in one of our large best hospitals, where she was told that she had a gastric ulcer. During two weeks of the time that she was in this hospital she had seven hemorrhages of dark red blood from the stomach. During the past three years she has had burning pain in the epigastrium, coming on from one to two hours after meals, and lasting until she vomited. While in the hospital she was treated for a number of weeks with Einhorn's duodenal bucket.

Physical examination by Dr McWilliams revealed an abdomen which was rigid all over, but more intensely so in the right upper quadrant, where there was also acute tenderness. No fluid could be made out in the abdomen, and the entire liver dulness was obliterated.

Operation was performed five hours after the onset. Gas was administered, supplemented later by a few drops of ether, and the principle of anoci association was employed in opening the abdomen, novocain being injected into the skin, aponeurosis, rectus muscle and peritoneum. This was supplemented by injecting urea and quinine solution along and into the rectus muscle an inch away from its incision. On opening the peritoneum there was no escape of fluid, and the congested stomach presented. On drawing the stomach to the right, fluid escaped in considerable amount. Through the stomach was felt an induration on the posterior wall, about an inch and a half proximal to the pylorus, of the size of a silver dollar. The lesser omentum was opened with the finger, and the posterior wall of the stomach rolled out into sight. A perforation about the size of a knitting needle was seen about an inch from the lesser curvature, in the centre of the induration. The stomach was very large, seemed atonied, and was full of

BONE GRAFT FOR DEFECT OF LOWER JAW

The question was whether there was a simple dilatation from atony of the stomach, or whether the dilatation was dependent on obstruction of the pylorus due to spasm. It seemed more than reasonable to suppose that spasm, caused by the ulcer, was responsible for the mechanical obstruction, so, fourteen days after the first operation, Dr. McWilliams did a posterior gastro-enterostomy with suture. The stomach was large and dilated. There was no organic stenosis of the pylorus, as a finger could easily be passed through it. The induration of the ulcer could readily be palpated. There was no other ulcer present, either in the duodenum or in the stomach. The ulcer did not seem to impinge on the pylorus. The site of the old perforation was adherent to the under surface of the liver, but there were no other adhesions.

Convalescence was smooth and uninterrupted. Rontgenograms taken three weeks after the gastro-enterostomy showed a marked change for the better. Prior to the operation there was a marked retention of bismuth after six and twenty-four hours. Three weeks after the operation the amount of bismuth remaining in the stomach after six hours was just about one-half that remaining prior to the operation, while after twenty-four hours there was none whatsoever remaining in the stomach. This was a great improvement. Since the gastro-enterostomy, now about five weeks ago, there has been no vomiting nor any discomfort, and the patient could eat everything. From all the evidence it would seem that the dilatation was due to obstruction caused by the pyloric spasm.

BONE GRAFT FOR OSTEOMYELITIC DEFECT OF LOWER JAW

Dr. McWilliams gave the history of a patient whom he presented, a woman, 33 years of age, who had been sent to him by Dr. Downs. Her chief complaint was of displacement of the lower jaw and inability to chew. Two years ago she had pneumonia. Four months afterward two small, hard lumps appeared on the under surface of the lower jaw. These were not painful until two months after their onset, when she had pain like a toothache, and both lumps discharged, one on the inside and the other on the outside of the mouth. She went to a hospital where, during a curetting of the bone, the jaw was accidentally fractured. For four months a plaster-of-Paris bandage was worn, during which time pieces of bone were discharged. Two of them were over an inch long. Bacteriological examination showed that the infecting organism was the pneumococcus. Nine months ago the larger right fragment of the lower jaw was wired to the upper so as to prevent its

fluid Some of this fluid had extravasated into the lesser sac and had then gone through the foramen of Winslow, collecting deep in Morrison's pouch The stomach was so large that it overlay this free fluid There were no adhesions anywhere The perforation was closed by Lembert sutures of silk, and was covered by a tab of fat from the lesser omentum The finger was passed through the pylorus easily by invaginating the stomach before it, and there was no organic stenosis In view of the situation of the ulcer away from the pylorus, a gastroenterostomy was deemed inadvisable The gutter to the outer side of the ascending colon and the pelvis were flushed out with salt solution In the pelvis was some fluid, but since there were no food particles in this fluid the abdomen was closed without drainage The immediate convalescence was very smooth The urea and quinine injection into the muscle seemed to much decrease the local pain in the wound, none being complained of, and the post-operative distention was practically nil Nothing was given by the mouth for three days, during which time the Murphy drip was employed During the first twenty-four hours 10 pints of fluid were taken up by the rectum, and 12 pints in the second twenty-four hours There was no vomiting until the third day On the second day pituitrin, 1 c c, was administered hypodermically, every four hours, and a colon irrigation was given twice daily On the third day the patient vomited three times At 10 P M of that day there was considerable upper abdominal distention, due to a distended stomach A tube inserted evacuated 2,500 c c of thick, brown fluid There was much relief following this procedure There was no vomiting on the fifth, six or seventh days, but on the eighth day the patient vomited 1,200 c c, and on insertion of a tube 1,600 c c of fluid were evacuated by siphonage For the next three days the stomach was washed out twice a day and each time, on insertion of the tube, from 600 to 1000 c c of fluid was evacuated by siphonage The wound healed by primary union On the twelfth day roentgenograms were taken of the stomach The plates showed a large stomach with strong peristaltic waves The antrum was of enormous size The stomach outline showed no evidence of ulcer The duodenal shadow was not evident at all Three hours after a bismuth meal more than one-half the ingested bismuth remained in the stomach, six hours thereafter more than one-quarter of the bismuth, while after twenty-four hours a great deal of the bismuth still remained in the stomach Some of the bismuth seemed to go through the pylorus even after three hours, but most of it appeared to stop abruptly at the pylorus

BONE GRAFT FOR DEFECT OF LOWER JAW

fragments, and aluminum bronze wires were inserted and twisted and the ends cut off. Wires were used because it was feared that the strain on catgut would be too great. The skin was closed with silk without drainage. A bandage was placed about the lower jaw so as to hold it immovable against the interdental splint on the upper jaw.

A week after the operation a little serous discharge appeared in the front of the incision and in a few days this became purulent. There was never at any time any temperature. The discharge never amounted to more than three or four drops, but was purulent.

On the fiftieth day after the operation, using novocain locally, the speaker removed both wires. The anterior wire was the only one infected, but for safety's sake both were removed, since they had done their work by this time. The graft looked smooth and pink and seemed to be perfectly alive, and was fast in its position (Figure 4). The posterior wire was imbedded tightly in connective tissue, and there was no fluid exudate about it. The anterior wire, on the contrary, was surrounded by granulation tissue and there was some purulent exudate about it and in the meshes of the granulation tissue. Were he to do this same case over again, notwithstanding the infection, he would use wire again rather than catgut, since there was so much pressure on the graft, which was wedged in, which would tend to displace it. The slight amount of infection, in his opinion, will not injure the life of the graft. The wires remained in place long enough to accomplish their purpose, that of holding the graft in its proper place until it should become fast.

An interdental splint was chosen rather than fixing the right larger fragment against the upper teeth with wires because it was deemed best to form the interdental splint so that it would exert a pressure upon the smaller left fragment to force it backwards. In addition wires become continually loose. Since the anterior end of the posterior fragment was free, there was a constant tendency for it to be drawn forwards by the action of the muscles. The pressure of the splint on the soft parts overlying the fragment in the mouth, it was hoped, would overcome this tendency.

A roentgenogram (Fig. 4) taken immediately after the wires were removed (fifty days after the grafting) showed that the graft was much larger than the original graft, due to the proliferation of the periosteum, which at the time the graft was taken from the tibia, was purposely cut larger than the bone section itself. Where one wishes a graft to increase in size, it is advisable that the periosteum be as voluminous as possible. Experience has shown, however, that, when the patient begins to use her jaw in chewing, nature will respond to

displacement inwards and backwards, so that chewing has been impossible. The sinuses have all been healed now for some months.

Physical examination clearly revealed the defect (see Fig 3). The horizontal border of the vertical portion of the bone ended in a triangular point. The right half of the bone ceased at the left canine tooth, leaving a defect of about an inch and a half to be filled in. The teeth of the right half were held in place with regard to the upper jaw by wires, so that the right side was in perfect alignment with the upper teeth.

The first operation was undertaken on November 6, 1914. In making an incision great care was taken to prevent going through the mucous membrane into the mouth. The tissues were very adherent to the bone, from which they were stripped with the elevator. The triangular tip of the vertical half, along the dotted line BC, was removed. The necessary mobilization of the posterior fragment was accomplished only after the entire surrounding tissues were stripped from the bone by the elevator on its outer and inner sides, extending up as high as the condyle. Fear was entertained for the future blood supply of the bone, but this anxiety was subsequently proved to be needless. The fragment was sutured in its posterior position. The motion, even with this extensive separation, was not yet free enough, so the coronoid process was divided at its base with a chisel. The motions of the fragment were then perfectly free, showing that the temporo-maxillary articulation was free and uninvolved. The fragment was then fixed in its proper posterior position with chromic gut, and the skin was closed without drainage. Healing was by primary union. The wires holding the right fragment were removed at the time of this operation.

The question of the best method of holding the fragments was placed in the hands of Dr Henry S Dunning and Dr V E Mitchell, who made an interdental splint which held both fragments in their proper relations. Eighteen days after the previous operation, a bone graft was inserted to fill up the defect. Great care was taken, in making a furrow to lodge the graft, that the cavity of the mouth was not opened into. The finger of an assistant in the mouth was a great help in preventing the opening of the mucous membrane. A graft of the requisite length was taken from the tibia, with its periosteum. The periosteum was cut larger than the bone section and reflected back onto the graft. The ends of the fragments of the lower jaw were freshened with the chisel, and each was drilled, as well as both ends of the graft. The graft was forced into place between the ends of the

CARCINOMA OF THE STOMACH

and the defect closed. The procedure narrowed somewhat the lumen of the stomach near the pylorus, so that it seemed advisable to do a gastro-enterostomy. The usual no loop posterior operation was done. Examination of all other abdominal organs failed to show any abnormality.

The report on the portion of the stomach removed and the omental tab was made by Dr. Elser of the New York Hospital, who reported that "the specimens consist of a portion of the stomach wall and a piece of omentum about 2 cm. in diameter and 1 cm. in thickness. The appearance of the omentum suggests strangulation. The microscopical examination confirms this. The tissue is infiltrated with blood, and the interlobular septa are invaded by numerous pus cells. Microscopical examination of the stomach wall shows practically no changes in the mucosa or musculature. The outer coat is infiltrated with fibrin and blood which also cover the surface at this point."

Dr. Elser suggested the diagnosis of torsion of the omentum. There certainly was no evidence of ulcer in the portion of the stomach removed nor in the contiguous portions so far as these could be seen through the excision opening. The long standing history was, however, very indicative of ulcer, and the findings in the omentum could hardly explain these. The case was presented because the lesion found—a torsion of part of the lesser omentum—was unique in the experience of the speaker. It might easily be confused in its symptomatology with a subacute or acute gastric perforation.

CARCINOMA OF THE STOMACH SUBTOTAL GASTRECTOMY

DR. HARTWELL presented a woman, aged 48, who had suffered from severe gastric symptoms for one year. She was admitted to Bellevue Hospital on December 29, 1914. Examination then showed a very distinct localized tenderness over the stomach, near the pylorus, and a tumor was indefinitely palpable. The gastric analysis showed normal acid content and no blood. The radiograph gave evidence of a defect in the gastric wall near the pyloric end, and this was made more evident by fluoroscopic examination.

Operation was performed on January 9, under gas ether anæsthesia. Incision through the right rectus line. The operation of Polya (*Zentrbl. f. Chn.*, July 1, 1911) was performed, using the Payr clamps. This procedure following the technic as described by Mayo (*Surg., Gynec. and Obstet.*, December, 1914) was remarkably easy of execution. It permitted the removal of the stomach well beyond the line of choice—more than could have been readily done had the method of a posterior

the extra strain on the living graft by causing it to grow to a size necessary to sustain all force put upon it. During this period of increasing growth care must be taken that the force shall be gradually increased, and that no sudden great strain be put on the jaw, in order that the graft be not fractured.

DR E M FOOTE had observed that some patients who have lost a part of the lower jaw are able to increase their power of mastication to a considerable extent by the education of the muscles of the other side. In some instances he had noted as good mastication with the back teeth as if there were perfect alignment of the incisors.

TORSION WITHIN THE LESSER OMENTUM SIMULATING SUB- ACUTE PERFORATION OF A GASTRIC ULCER

DR JOHN A HARTWELL presented a woman aged 53, who came under his care in December, 1914, giving the following history:

For many years she had suffered from symptoms which had been diagnosed as arising from a gastric or duodenal ulcer. In 1911 a very severe hemorrhage took place and she was kept in the hospital for four weeks undergoing a dietetic cure for gastric ulcer. This resulted in a very marked improvement, but the symptoms were still present to a less degree, and gradually grew more marked. In October, 1914, she was again suffering a good deal, and on one occasion passed a large amount of tarry blood per rectum. Since that time the old symptoms had steadily increased. On December 15 she was seized with severe abdominal cramp which centered in the right side. This was accompanied with vomiting. The pain subsided somewhat, but two days later a second very severe attack occurred. Examination at that time showed a marked rigidity of the right side of the abdomen, and evidence of considerable pain. There was an area of marked tenderness in the upper abdomen, at the site of the pylorus. Temperature was 100. Pulse 64. White blood cells 10,000, of which 76 per cent were polynuclears.

A diagnosis of subacute perforation of a gastric ulcer seemed reasonably certain, and operation was done under gas ether anæsthesia. The usual right rectus incision was made. In the lesser curvature of the stomach, near the pylorus, was a thickened area over which there was a mass of fat—apparently a tab connected with the lesser omentum—adherent to the stomach and twisted in such a way that it was practically gangrenous. On separating it there remained considerable thickening in the stomach wall which was ascribed to an old ulcer beneath. This portion of the stomach was accordingly resected between clamps,

manifest During his more lucid intervals an inco-ordination in the movements of the left arm and asternognosis were made out The blood gave a strongly positive Wassermann reaction, but the spinal fluid did not.

On December 12th all the symptoms *suddenly* showed a marked increase, and it was apparent that there had been a sudden increase of intracranial tension, with its maximum point over the lower post-rolandic area, and it was evident operation alone could give relief.

Anæsthesia was produced by the drop ether method, very little being required A cutaneo-osteal flap, horseshoe in shape, 9 x 6 x 4 cm, was turned down, the hinge lying just above and anterior to the auditory meatus, and the broad part near the great longitudinal fissure over the Rolandic area The bone flap was cut with the ordinary broad amputating saw into the inner table and then separated with a few taps on a broad astertome This procedure required less than ten minutes, and was very easy of accomplishment On exposing the dura it was seen to be under tension, without pulsation, and seemed much increased in vascularity. On incising it and turning down a similar flap to the bone flap there came into view a large disc-shaped clot with its maximum thickness of 3.5 cm lying over the post-central and pre-central gyri, near their lower ends The brain in this region was depressed a corresponding distance below the skull The diameter of the clot was about 8 cm and the circumferential portions were very thin. It was estimated to equal about 4 oz The dura, in the portions where no clot existed, was about twice the normal thickness, and its under surface was markedly vascular, showing a velvety appearance The clot was firmly adherent to the dura, and on this surface was completely organized The surface of the clot next the leptomeninges was much more recent and did not adhere There was no evidence of any trauma to the skull or brain The leptomeninges were intact, and there was no escape of cerebrospinal fluid

After removing the clot the operation wounds were sutured The patient made a prompt recovery All symptoms had subsided in about a month, during which time he had received mercury and iodide

The microscopical examination of a small section of dura remote from the clot showed a chronic inflammatory thickening There was an increase of connective tissue and a round cell infiltration The dural surface of the clot showed a complete organization There was a layer of fibrous tissue which was well vascularized, arteries, veins and capillaries all being present The deeper portion showed only coagulated blood

gastro-jejunostomy been followed. The post-operative course was unusually satisfactory, and in less than two days the patient was entirely free from pain. There had been no vomiting. The pathological findings at operation, and the report on the specimen made by Dr. Vance, the divisional pathologist, were as follows:

Pathological findings. "On the anterior wall of the stomach, just proximal to the pylorus, and extending to the greater curvature is an indurated ulcerated area about 3 cm. in diameter, through which could be felt a deep crater. Recent adhesions drew the stomach down to the pancreas. The lesion is definitely confined to the gastric side of the pylorus. There are two slightly enlarged lymph-nodes in the gastro-colic omentum near the pylorus. The histological examination confirmed the diagnosis of adenocarcinoma of the stomach."

DR. JOHN F. ERDMAN said the Pólya operation could be very nicely and quickly performed in cases of perforating duodenal ulcer. He had employed it in seven cases within the last six weeks, five of which were for ulcer duodenal and three for gastric carcinoma. He cited one case in which he resected about four-fifths of the stomach. He has about discarded the Payr clamps, using instead the Moynihan and Marots clamps, which he found more satisfactory in suturing the stomach, as these clamps are not as clumsy as the Payr's.

PACHYMENINGITIS HEMORRHAGICA INTERNA

DR. HARTWELL presented a man, aged 49, who was admitted to Bellevue Hospital on November 21, 1914. He had received a head injury on that evening. On admission there was a small scalp wound over the right eye, but no evidence of fracture. He was in partial coma, and gave evidence of being deeply intoxicated. On rousing him he showed great irritability. There was some muscular weakness in the left face and arm. The left abdominal reflex was absent and all other reflexes were increased. A spinal puncture withdrew 5 c.c. of fluid which contained no blood. There seemed some increase in pressure. The eye grounds showed some obscurity of the discs and a slight tortuosity of the vessels.

During the subsequent ten days he showed alternating improvement and retrogression. Some days he was quite clear in his mind and all the symptoms seemed subsiding—except that there always remained a varying amount of weakness of left face and arm, and the eye grounds did not become normal. He acknowledged being a heavy drinker. On other days he would lapse into complete irrationality, with a tendency toward coma, and the disability in the left side would grow more

RUPTURE OF THE GASTROHEPATIC OMENTUM

of an ulcer. The pylorus was found in its normal situation and there was no stenosis at this point. The stomach appeared as an elongated U-shaped tube, wider at its lowest point. An attempt was made to facilitate evacuation of the stomach by a posterior gastro-enterostomy (done on September 3), assuming that at least a certain degree of gastric atony was present. Exclusion of the pylorus was not practised. The condition was in no manner relieved by this procedure. The patient continued to vomit everything, and had to be kept alive by artificial feeding and hypodermoclysis. On September 25 the abdomen was reopened, and, upon finding a somewhat distended duodenum, an anastomosis was established between the afferent and efferent loop of the gastro-enterostomy. There was no improvement after this second operation. Vomiting persisted in spite of daily lavages, and artificial feeding had to be continued until October 26, when the patient was practically reduced to a skeleton. On this day, after several ineffectual attempts, the operator was able to introduce a tube into the jejunum and to begin feeding. (The position of the tube was controlled by X-ray examination.) This was continued for twenty-one days, when the tube had to be removed. On this day the patient was much improved. She now weighed seventy-five pounds, and she was able, after this, to take a little food by the mouth, which was rapidly increased in quantity, vomiting having entirely ceased. She left the hospital four or five weeks later in very good condition, being entirely cured of all her symptoms. To-night she weighs 108 pounds and is, to all appearances, in good health.

The speaker said he had shown this case to accentuate the difficulties in determining the curative factors in many of these cases of gastroparesis in neurasthenic individuals, who had been subjected to operative procedures on the stomach. He was well aware that the time which had elapsed was too short to make any statement regarding the permanency of the good result obtained in this case.

RUPTURE OF THE GASTROHEPATIC OMENTUM

DR N W GREEN presented a boy, eight years of age, who was run over by a light ice wagon when six. He was carried by the ambulance to the Reception Hospital, and from there he was admitted to the surgical service of the City Hospital. He repeatedly gave a definite history of the wheel of the wagon having passed up his left leg and across his abdomen. On admission he appeared alert and somewhat in shock, with no rise in temperature, and with slight quickening of the pulse rate. His leucocyte count was 15,000. Upon physical ex-

Dr Norris diagnosed the condition as pachymeningitis hemorrhagica interna

The case was shown because it presented evidence controverting an article published by Mr Wilfred Trotter, in the *British Journal of Surgery*, October, 1914, in which he assigned trauma with hemorrhage as the etiological factor in this disease. He says the trauma primarily causes bleeding and that it comes from the veins passing into the sinuses from the brain, and that the term meningitis is a misnomer.

This case showed direct evidence of a meningitis at a considerable distance from the hemorrhage. The greatest extent of the hemorrhage was not contiguous to a sinus. The clot was directly vascularized from the dura. The course of the disease was therefore a primary inflammatory lesion of the dura. An increased vascularity of the under surface was an expression of this inflammation. A slight trauma started a vicious hemorrhage from these vessels and this slowly progressed as the older parts organize and new vessels form in them. The advance and retrogression of the symptoms so characteristically shown in this case were thus explained.

Dr Hartwell said he had personally operated on three similar cases and the museum at Bellevue and the Cornell Medical College afforded additional autopsy specimens.

The term *pachymeningitis hemorrhagica interna* was therefore exactly descriptive and should be retained.

GASTRO-ENTEROSTOMY FOR GASTROPTOSIS

Dr Frederic Kammerer presented a woman of 27, who had been suffering several years from symptoms of dyspepsia, accompanied by occasional vomiting and loss of weight. About six weeks before her admission to the hospital the symptoms became more acute. She had pain very soon after every meal, and began to vomit continually. The vomited material contained blood at times. When first seen by the speaker, last August, she was very much emaciated. Physical examination revealed a marked gastroptosis. An X-ray examination was impossible, owing to the fact that the patient could not retain any bismuth. At an exploratory operation a typical, so-called, water-trap stomach was found, the larger curvature lying almost in the pelvis and the middle of the lesser curvature being situated about three inches below the umbilicus. There was an extensive formation of bands about the caput coli and ascending colon, these were separated and an appendectomy was done for a very long and adherent appendix. A careful examination of the stomach failed to reveal anything suggestive

SURGICAL TREATMENT OF GASTROCOLOPTOSIS

THE SURGICAL TREATMENT OF GASTROCOLOPTOSIS

DR JOHN DOUGLAS read a paper with the above title, for which see page 545

DR ROBERT T. MORRIS thought it quite important, in dealing with cases of relaxed peritoneal supports, to understand that the visceroptosis represents stigmata which, with various other stigmata, make one perspective in a large picture. He generally practised all the principles prescribed for this condition of the stomach and colon, and had found that many of these patients get quite as well by other methods as by operation. In one group of these cases almost anything one might do for them would make them better. They liked to respond to treatment. The numerous methods of support which could be given without operation were sometimes effective. Goldthwaite, of Boston, for example, used a support, and all his patients seemed to improve. Goldthwaite's support, Rose's belt, and all the other, however, had their objections. He had performed gastrorrhaphy, taking a tuck in the stomach, he had employed the Rovsing operation and all the others, and the result was that most of the patients had been benefited—because something had been done for them. There was, however, a second group of cases with very different effects—the toxic group. These patients suffer from intestinal toxæmia, having a condition which he had described as "cobwebs in the attic." Unless these cobwebs were separated the motility of the pylorus would be interfered with, and a long chain of secondary symptoms, familiar to all, would be inaugurated. With the employment of sufficiently vigorous treatment,—massage, mountain climbing, climbing stairs, etc.,—these patients would be benefited just so long as they were prodded, so to speak. They were neurasthenics, however, and must be prodded.

DR WILLIAM A. DOWNES considered the class of patients under discussion definitely ill. Many of them could not take prolonged rest, do mountain climbing, and resort to the other measures mentioned. Many of them were working men and women and must return to work as soon as possible. For that reason, operative relief of some sort was indicated, and if the operation suggested by Dr. Douglas was successful it was preferable to more radical procedures. However, the speaker had not been so fortunate in obtaining good results from the various fixation operations, and therefore had resorted to gastro-enterostomy with pyloric occlusion in eight cases. The pylorus was closed in five instances by means of a heavy Pagenstecher ligature, and in three instances a complete division with inversion was done. In one case,

amination his abdominal muscles were moderately rigid. He had diffuse tenderness over the whole abdomen. There was indefinite dullness on percussion in both flanks. There was a point of ecchymosis on the right side on a level with the umbilicus. As he appeared to be suffering from peritoneal irritation, and as the ecchymosis was directly over the liver, it was thought advisable to open the abdomen. At operation the same afternoon bloody fluid escaped from the peritoneum. Oozing but no active bleeding was located in the torn gastrohepatic omentum (a one and a half inch rupture being present near the right hand border). No further injury to any viscus could be detected, but owing to the force exerted by the weight of the wagon it was feared that some injury to the gut might have been done, and so a tube and cigarette drain was inserted to the site of the laceration, the wound being then closed, except for this drain.

The same evening the patient vomited some thick brown fluid. The cigarette drain was removed the next day. Four days after operation there was a discharge of pus with a slightly greenish tinge. Ten days after operation the discharge had a suggestion of sourness in odor. On the thirteenth day the discharge was decidedly sour, with a distinct odor like stomach contents. Fourteen days after operation the discharge was very slight and the drainage opening was closing. Four weeks after operation the patient was discharged cured.

The patient was shown on account of the unusual nature of the injury.

DR A. V. MOSCOWITZ recalled the fact that a number of years ago he had presented before the Society a case which was absolutely identical with the one presented by Dr. Green. He did not feel warranted in operating upon the patient in the beginning, but finally the condition became such that he was compelled to operate. There was a quantity of blood in the abdomen. Careful search revealed only a small tear in the gastrohepatic omentum. The patient made a good recovery.

DR. FREDERIC KAMMERER recalled the case of a young boy, who had come under his observation some years ago in which, after injury, an internal hemorrhage occurred. At operation the entire abdomen was filled with blood. A most careful search failed to reveal the seat of the hemorrhage, which was, however, evidently located in the upper abdomen. The abdomen was closed and the patient recovered without further complications. The speaker thought he might have overlooked a rupture of the gastrohepatic omentum in this case, as the hemorrhage had ceased at the time of operation.



FIG 5—Enchondroma of tibia (lateral view)



FIG 6—Anteroposterior view

which had been presented before this Society, vomiting recurred, but in the others the result had been extremely satisfactory. It was a radical operation, but so far there had been no complications and it seemed worthy of trial in selected cases. Dr Downes presented lantern slides illustrating two of the cases before and after operation.

DR GEORGE WOOLSEY, recognizing the fact that something must be done for patients who cannot afford to undergo prolonged treatment, had employed, in several cases of this kind, the method proposed by Coffey. One patient, who was markedly neurasthenic, had not been benefited. The others were very much improved. He had never employed the Rovsing method to correct gastropnoxis, but he had used it twice where he did gastro-enterostomy for a large, dilated stomach, with pyloric stenosis, to temporarily support the stomach and prevent traction on the suture line, at the stoma. The stomach was suspended temporarily by this method, using silkworm-gut suture, which was removed ten days later. One of these patients, a woman who had suffered for twenty years with "stomach trouble," wrote him one year after the operation, that she had had no trouble, and that she had gained much in weight. In none of the cases was peristalsis interfered with by the operation.

DR H H M LYLE had employed the Coffey operation in three cases, and in each instance the patient was made worse.

DR W B COLEY showed the following patients

I. CANCER OF THE RIGHT TESTIS RECURRENT IN THE LEFT SUPRACLAVICULAR GLANDS AND LEFT LUNG

M J F, 28 years, dentist by occupation, family history good. No trauma. Personal history. Nothing worthy of note until September, 1912, when he first noticed a swelling in the right testis, which slowly increased in size, no pain. Three months later, removal was done by Dr John Blue of Montgomery, Ala. The testis and cord were removed as high up as possible.

Microscopical examination. Small round-celled sarcoma. Patient remained well for about two years. In the beginning of November, 1914, he noticed a swelling of the left supraclavicular glands, which rapidly increased in size. November 15, removal by Dr Moody, who found the growth so adherent to the subclavian vein that it was impossible to make a complete removal. Microscopical examination showed the second specimen to be the same type of sarcoma as the first one.

X-ray taken of chest showed several areas of apparent involve-

ENCHONDROMA OF THE TIBIA

ment The patient had noticed slight enlargement of the anterior portion of the thorax on the left side

Physical examination, December 28, 1914, showed absence of the right testicle, no retroperitoneal involvement Examination of chest showed slight enlargement of anterior portion of left thorax, some dulness on percussion, no râles Just above the left clavicle was a tumor the size of a hen's egg—or slightly larger—made up of enlarged glands, more or less fused together, and fairly movable, skin not adherent, but slightly purplish in color; deeper gland by the clavicle apparently involved

Patient's general health good, weight, 136 pounds (perfectly normal) No cachexia Slight hacking cough, no blood in sputum Clinical diagnosis: Recurrent metastatic sarcoma of the testis December 28, 1914, was referred to General Memorial Hospital for toxin treatment

Pathological Report—Recurrent tumor of supraclavicular region. Material consists of a large encapsulated soft mass as large as a hen's egg Section shows a malignant tumor of large, clear, polyhedral cells, closely webbed together, but with clear fine borders, arranged in small and large groups, inclosed in hyaline, necrotic or fibrous tissue Cells merge smoothly into supporting tissue No pigment Few myeloid giant cells Some radially striated foreign bodies inclosed by cells No diagnosis. Possibilities (1) endothelioma, (2) melanoma, (3) metastatic carcinoma A search for primary tumor is indicated (By some mistake a copy of the clinical history was not sent to the pathologist)

This case shows the extreme difficulty in classifying malignant tumors of the testis The older tendency to regard them all as sarcomas has yielded to the more recent and increasing tendency to classify them all as carcinomas, or teratomas with carcinomatous degeneration In view of the great difference of opinion among pathologists Dr Coley believes, it best to group all malignant tumors of the testis under a single head, "cancer" This has been done by Chevassu and others Another important point brought out by this case is that in certain instances there is no indication for the formidable operation—strongly urged by Chevassu, France, and more recently by Hinman of Johns Hopkins—*i e*, the removal of the preaortic glands as a routine measure in cases of sarcoma of the testicle

II ENCHONDROMA OF THE TIBIA WITH TRAUMATIC DETACHMENT

W W, male, age 32 years, was referred to Dr Coley on January 8, 1915, with the following history: Family history good No history of specific disease or tuberculosis. No local trauma.

TRANSACTIONS OF THE PHILADELPHIA ACADEMY OF SURGERY

Stated Meeting, January 4, 1915

The President, DR JOHN H GIBBON, in the Chair

CARCINOMA OF FLOOR OF MOUTH

DR ASTLEY P C ASHHURST presented a man, aged fifty years, who over a year ago began to have trouble in the floor of the mouth, between the frænum and the symphysis. When first seen by Dr Ashhurst in August last, there was present a foul odor, and the man was dizzy from weakness on standing. It seemed to be an inoperable case. On August 4, he injected eucaïne into the lingual nerves and tried to divide them. Ten days later he gave him ether by the intrapharyngeal method and cauterized the mouth. Then the man gained seven pounds in two weeks. He was able to eat and sleep well, and went home for a holiday. Two weeks afterward, under intratracheal insufflation anæsthesia, he removed the glands on the left side of the neck, including the sternomastoid muscle, but leaving important nerves that could be saved. This shocked him very much and he lost ten pounds. Four weeks later he operated on the right side of the neck, in a similar manner. In the second operation he had to sacrifice the spinal accessory and hypoglossal nerves. At both operations on the neck the floor of the mouth was thoroughly cauterized from the neck wounds. There are now, more than three months after the last operation, no signs of carcinoma in the floor of the mouth. He has good use of the neck and head and eats and sleeps very well and can make himself understood in conversation, though the tongue is almost immovable. He has gained thirty-one pounds in weight.

The pathological report showed involvement of the glands of the upper part of the neck but not of the lower.

The interesting point in this case is the value of the cauterization of the floor of the mouth, with the cautery almost at a black heat, first from within the mouth, and subsequently from the neck wounds. The disease certainly has been arrested.

RECOVERED EMPYEMA

DR NATHANIEL GINSBURG presented a man upon whom a partial rib resection for empyema of the thorax had been done at the Philadelphia Hospital, in February, 1914, the incision being located in the

About 8 years ago noticed a small hard lump just under the left leg, a short distance below the popliteal space, apparently attached to the bone. This swelling gradually increased in size without causing any pain or disability. About a week before Dr. Coley saw him, he had a slight fall in which the leg was wrenched. The patient felt something snap, and had pain and increased swelling of the calf of the leg after the injury. He consulted Dr. Shaw, of Coshocton, Ohio. An X-ray photograph was taken of the leg, and the diagnosis of the radiologist was osteosarcoma (Figs 5 and 6).

Physical examination at the time of Dr. Coley's first observation (January 8) a week after the injury, showed the left calf of the leg about twice the size of the right. A fluctuating smooth symmetrical tumor was found situated directly under the upper part of the muscles of the calf. On deep palpation there could be detected—in what seemed to be bottom of a cyst—a hard, movable, mass of bony or cartilaginous consistence. Dr. Coley's clinical diagnosis was enchondroma or osteoma, which had been broken off from its attachment to the base of the tibia by the recent trauma. Dr. Coley advised exploratory operation, and on January 20, under ether anæsthesia, he made an incision directly over the inner portion of the calf of the leg, and came down on what appeared to be a cyst with greatly thickened walls. In cutting through the latter, about 8–10 ounces of reddish serum were evacuated. The posterior wall of the cyst contained a tumor, made up chiefly of cartilage. The cyst wall together with the tumor was removed. Opposite the tumor, and about an inch away was found a sharp bony projection from the posterior surface of the tibia—apparently the proximal portion of the pedicle from which the tumor itself had been recently broken off. This was removed by rongeur forceps, and the wound closed with drainage.

The present specimen shows very clearly the conditions described. The cyst walls were doubtless formed by constant irritation, caused by the rubbing of the tumor against the muscle during the long period of formation. The gross specimen shows the tumor to be unquestionably an enchondroma. The report on the microscopical section has not yet been received.

Clinically it is a benign type of enchondroma, microscopically there is little difference between the pedunculated slow-growing enchondroma, which is practically benign, and the diffused form, which is most frequently seen in the ilium, and which is, clinically, a chondro-sarcoma of the femur with a high degree of malignancy.



FIG 1 —Proliferating epitheloma of the sigmoid

midaxillary line, removing a portion of the rib. When first observed by Dr Ginsburg, there was a foul profuse discharge from the drainage tract, with temperature, loss of weight and great prostration.

He injected bismuth paste into the sinus, and for a time marked cessation of the discharge resulted, but later the man grew rapidly worse and impending death seemed certain. A skiagraph showed what was interpreted by the radiologist as a large subphrenic collection of pus in the right pararenal area. After a careful exploration of the kidney area through a loin incision, no subphrenic collection of fluid was discovered. At a second operation, a week later, Dr Ginsburg removed the ninth rib from the post-axillary line to the costochondral junction, and found that the picture of a subphrenic abscess proved to be a collection of decomposed bismuth paste which filled a long, isolated tract, extending anteriorly to the cartilage of the sternum. The reporter stated that he wished to emphasize, in reporting this case, that it is one of empyema in which the so-called posterior drainage to which Dr Thomas has recently called attention, and which at an earlier date had been discussed by some of the French School of Surgeons, and also recommended by Kocher in selected cases, was not feasible. He believed this patient gives reason for believing that many cases of pyothorax cannot be so reached, but must be drained at the point of aspiration. From the beginning this man apparently had a pus cavity which never would have been touched by posterior incision. Free exposure of the whole cavity and healing from the bottom removed the trouble. The case is the only one of four old cases of empyema recently seen which finally recovered.

RUPTURE OF THE BICEPS

DR EMORY G ALEXANDER read a paper with the above title, for which see page 608.

DR JOHN H JOPSON exhibited a patient showing the results of an operation for rupture of the long head of the biceps muscle, who was one of two upon whom he had operated for rupture of the long tendon.

This patient was injured a year ago in an accident on a schooner. He was raising a sail and was caught by a rope, which wound around his arms in such a manner that the left arm was practically torn off and was later amputated a few inches below the shoulder. The right shoulder and upper arm were also injured. When Dr Jopson saw him some months later, he exhibited the usual symptoms of rupture of the biceps muscle and, in addition to this, there was marked limitation of abduction and forward extension of the arm. He was operated on at this time and it was found that the long tendon had been torn about

PROLIFERATING EPITHELIOMA OF THE SIGMOID

3 cm above the belly of the muscle and the two fragments were connected by a thin, flaccid strand of connective tissue. The tendon was plicated and sutured to the short head of the biceps. The result was satisfactory as regards the power of flexion of the arm, although there is still some depression above the belly of the muscle. The limitation of abduction and forward movement of the arm caused the patient to return for further treatment. The head of the humerus was then exposed through an anterior incision between the deltoid and pectoralis major muscles and the lesser tuberosity was found to have been fractured and was attached at a lower level than normal, while the head of the bone was above and in front of the glenoid cavity. The lesser tuberosity was chiselled off subperiosteally, which permitted the head of the bone to be brought down nearer its normal location, and the arm was dressed at a right angle to the body and kept in this position for several weeks. The patient now shows marked improvement in the movements which were formerly almost abolished, viz abduction and forward extension, although the head of the bone is still above its normal location. With treatment by massage and passive motions further improvement is probable.

The other patient was a man, aged sixty-eight, who, while attempting to catch a heavy bunch of bananas, was struck by it, the weight falling on his arm. In this case, operation showed that the tendon had been torn from the edge of the glenoid cavity. It was sutured to the common tendon of origin of the short head of the biceps and the coracobrachialis muscles through a second incision just below the coracoid process, the tendon being made taut before it was attached. He had not been able to trace this patient.

PROLIFERATING EPITHELIOMA OF THE SIGMOID

DR GEORGE G ROSS reported the history of a man aged seventy, who suffered some 20 years ago from various digestive disturbances and some nervous symptoms which he thinks were due to his habits of life. Under treatment he improved and remained fairly well until two or three years ago when he began to fail. About the same time his wife's serious illness caused considerable anxiety and stress. After the result in her case became apparently hopeless, he himself ran down rapidly and has continued so until now. Has lost about 70 pounds in the last year or year and a half. His color, however, remained fairly natural. He has lately had some intestinal symptoms which seemed to point to the sigmoid region or perhaps lower. He is habitually constipated and constantly takes laxatives. He has dis-

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LIGATURE OF THE INNOMINATE ARTERY FOR CURE OF SUBCLAVIAN ANEURISMS

BY JAMES E. THOMPSON,¹ M.D. (LONDON), F.R.C.S. (ENG.),

OF GALVESTON, TEXAS

PROFESSOR OF SURGERY IN THE UNIVERSITY OF TEXAS

THE case which forms the basis of this communication was one of spontaneous aneurism of the axillary artery involving also the third and second parts of the subclavian. The sac was an enormous one, and reached from the scalene muscles above to the axillary outlet below. The axillary portion was many times larger than the subclavian.

Ligature of the innominate artery as a method of curing subclavian aneurisms must always be looked upon as a last resort. It must only be attempted if other methods are unsuitable in the particular case under treatment.

Savariaud¹ divides subclavian aneurisms into two classes, (1) extrascalene and (2) intrascalene, according to the position of the sac. Those belonging to the extrascalene variety can usually be treated without interfering with the innominate trunk, while those belonging to the intrascalene variety will often necessitate ligature of this vessel.

These aneurisms have been treated by the following methods (Savariaud).

I. Direct attack

(a) Open operation (Antyllus, Matas)

(b) Extirpation.

II Indirect attack (ligature)

(a) Proximal ligature (of the third, second or first part of subclavian, or of the innominate)

(b) Distal ligature (of third part of subclavian or axillary)

I DIRECT ATTACK—If the proximal circulation can be controlled

¹ Savariaud. Anévrysmes de la sous-clavière. *Revue de chirurgie*, 1906, t. XXXIV, p. 1.

charged blood from time to time, sometimes several times a day No particular local pain or soreness On examination there is some hardness of the sigmoid region but no very definite indications of a mass He is decidedly emaciated but not cachectic Constant starvation diet may account for some of this No renal symptoms of a definite kind Urine shows as follows Negative except for a heavy indican reaction, specific gravity 1022, a few casts X-ray shows an incomplete obstruction of the sigmoid about the middle This was best shown by X-ray of the bismuth injections from below Blood count Red blood-cells 4,520,000, white blood-cells 7,000, 79 per cent polynuclears, 66 neutrophiles, 27 lymphocytes, 3 large mononuclears, 0 transitionals, 4 eosinophiles

Operation (December 3, 1913) Left rectus incision Hard mass in middle portion of sigmoid demonstrated Outer layer of meso-sigmoid incised to mobilize the sigmoid Bowel clamped to either side of tumor Sigmoid cut through with actual cautery between clamps, proximal and distal to tumor, and five inches of sigmoid, containing the tumor (Fig 1) removed End-to-end anastomosis, proximal and distal end of sigmoid, using chromic gut for mucosa and muscular layer reinforced by linen suture for serosa Anastomosis reinforced by epiploic appendages which were sewn over side of anastomosis with linen suture Colon tube passed to point above anastomosis Colon tube sewn to anus with one silkworm-gut suture Wound closed in layers Dry dressing

The day following operation the patient developed a bronchitis without temperature The rectal tube was removed on the third day and the patient had a formed stool He subsequently showed abdominal distention, diminished urinary output, and finally died seven days after operation from uræmia

ANNUAL ORATION THE OPERATIVE TREATMENT OF ARTERIAL THROMBOSIS AND EMBOLISM

DR FRANCIS T STEWART delivered the annual oration, for which see page 519

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LIGATURE OF THE INNOMINATE ARTERY

important veins and nerves. The internal jugular and vertebral veins are directly in front of it, also the pneumogastric and phrenic nerves. At its origin, the right innominate vein forms an anterior relationship.

In cases of aneurism the venous trunks are usually greatly distended and block the approach to the artery. The numerous arterial branches hinder the passage of the aneurism needle. After a ligature has been successfully tied, the obliteration of the vessel is problematical, because clotting is impossible except in the immediate neighborhood of the ligature. If by any chance the wound becomes infected, secondary hemorrhage is very liable to occur at the site of ligature. If on the other hand massive clotting and extensive obliteration of the main arterial trunk occurs, the branches arising from it will become obliterated with serious embarrassment of the collateral circulation.

Secondary hemorrhage (twice in nine cases) and return of pulsation (three times in nine cases) have been too frequently observed to permit the operation to occupy a high place in our esteem (Savariaud). If ligature of the first part of the subclavian is contemplated, the site of ligature should always be distal to the origin of the thyroid axis so as to leave the suprascapular artery free to carry blood to the arm. If the ligature is placed proximal to the origin of the vertebral, it would hardly be wise to tie this trunk at the same time, especially if the collateral circulation was already embarrassed by the centrifugal pressure of the walls of the aneurismal sac. Blood flowing refluxly down the vertebral would probably be needed to supply the collateral circulation when the aneurism underwent consolidation. The same reflux stream would hardly be powerful enough to prevent consolidation. Ligature distal to the thyroid axis and vertebral would be more likely to be followed by consolidation of the aneurism.

Ligature of the innominate artery. In the treatment of intrascapular aneurisms, ligature of the innominate with or without simultaneous ligature of the carotid is usually the only procedure open to us.

Since the year 1880, the innominate has been tied 26 times for the cure of aneurism of the subclavian artery, with 12 recoveries and 14 deaths.

Table of cases of aneurism of the subclavian artery operated upon by ligature of the innominate artery since the year 1880 follows.

	Cases	Recoveries	Deaths
Spontaneous aneurisms	23	10	13
Traumatic aneurisms	3	2	1
Total	—	—	—
	26	12	14

by a clamp or temporary ligature placed on the subclavian the best method of treating these cases is by *direct attack*, *i e*, by opening the aneurism (Antyllus), cleaning out the clots, and securing the vessels opening into the sac. This part of the operation can be finished according to Matas' advice, either by an obliterative or possibly reconstructive aneurismorrhaphy. If effective hæmostasis can be obtained, the operation is very successful. Matas² reports 7 obliterative operations with only one death, *i e*, 95.4 per cent of successes. Savariaud speaks very highly of *extirpation* of the aneurismal sac. He collected 7 cases with one death. It is hardly likely, however, that this operation will survive. Compared with the Matas procedure it is more difficult, and however carefully the dissection is conducted, the collateral channels will be in danger of division.

II INDIRECT ATTACK—(a) *Proximal Ligature*—*Ligature of the subclavian artery*. Ligature of the *third part* of the subclavian artery. This is a highly successful operation. It has usually been employed in the cure of axillary aneurisms or in subclavio-axillary aneurisms in which a sufficient length of the third part of the subclavian artery outside the anterior scalene muscle was free from the aneurismal sac.

The artery is peculiarly suited for the operation. It is easily accessible and is usually free from branches. If a branch happens to arise from this part it is usually the posterior scapular. In extrascapular aneurisms the objective point should always be the third part of the subclavian. If inaccessible the ligature must be placed further up stream. Savariaud collected 9 cases with only 1 death, which occurred from embolism on the twenty-second day.

Ligature of the second portion of the subclavian artery. In some cases of extrascapular aneurism it may be found that no part of the third portion of the subclavian artery is suitable for a ligature. If the anterior scalene muscle is divided and the phrenic nerve retracted, the second portion of the artery can be exposed and tied. As would be expected, this operation is as successful as ligature of the third part, because the ligature is invariably placed below the superior intercostal artery, *i e*, below the branches which may be required as collateral channels. Savariaud collected four cases, all successful.

Ligature of the first part of the subclavian artery. Ligature of this arterial trunk has turned out to be a very unsatisfactory operation. It is both difficult and dangerous. The artery is very short, numerous branches arise from it, it is very deeply situated and is surrounded by

²Matas. Trans Internat Congress of Medicine, 1913, Lond, Eng. Surgical section. Discussion on the surgery of the arterial system.

LIGATURE OF THE INNOMINATE ARTERY

on the seventeenth day Electrolysis was employed and a cure resulted

The site of ligature is important It should be as near to the aneurismal sac as possible Under no circumstances must the ligature be placed distal to the origin of the posterior circumflex and subscapular vessels The site of ligature must be above these vessels If placed below, the circulation of the arm will be imperilled, and, further, the aneurismal sac will be in full connection with the collateral circulation from its distal side

ILLUSTRATIVE CASE

A J, aged forty-six, male, colored The patient was a powerful negro who was admitted to the John Sealy Hospital on June 22, 1914, suffering from a large pulsating swelling occupying the right axillary and supraclavicular spaces

Previous History.—The patient was a dock laborer and had daily been accustomed to most strenuous work until about seven years ago There was a positive history of gonorrhœal infection There was no history of syphilitic infection He had not been addicted to excesses in alcohol

Present Trouble.—The history of the onset of the axillary swelling was very vague Painful kernels (lymphatic nodes?) had appeared and disappeared in various parts of his body Six weeks ago a swelling (kernel) appeared in his right arm-pit Gradually the tissues in front of the right shoulder were involved Four days before admission, the arm began to swell, and he suffered from intense pain in the back of the hand and wrist Before this period he had no knowledge of the existence of a swelling either above or below the collar bone

On admission, the condition of the patient was as follows He was a magnificent specimen of manhood, although somewhat emaciated and careworn His facial expression was eloquent of suffering (see Fig 1) Occupying the whole axillary space of the right side was a huge swelling which extended upward above the clavicle into the supraclavicular space The right arm and forearm were greatly increased in size and the skin was stretched and tense and very œdematous Large veins could be seen in the subcutaneous tissue of the arm and forearm The arm and forearm were swollen and œdematous He complained of almost constant pain of a boring, burning character in the hand and wrist, which was alleviated by raising the shoulder

The axillary and supraclavicular swellings were continuous On inspection the outline of the clavicle was obliterated, but it could be palpated clearly Over the surface of the tumor pulsation of a typically expansile character was visible and palpable

	Cases	Recoveries	Deaths
Ligature of the innominate artery alone	12	5	7
Ligature of the innominate and carotid simultaneously	12	7	5
Ligature of the innominate, carotid, and vertebral simultaneously	2	0	2
	—	—	—
Total	26	12	14

The death roll (14 deaths in 26 cases, *i e.*, 53·8 per cent) is enormous, but the disease is almost certainly fatal sooner or later unless treated by surgical means

The operation is one of last resort and should only be attempted if ligature of the subclavian artery in some part of its course is impossible

In intrascapene aneurisms no other course is open. The first part of the subclavian is occupied by the aneurism and inaccessible to ligature. In extrascapene aneurisms it would probably be wiser to attempt to place a ligature on the first part of the subclavian, and failing in this to tie the innominate and carotid.

(*b*) *Distal Ligature*—In the treatment of subclavian aneurisms, distal ligature ought to be given proper consideration, particularly in cases where proximal ligature is impossible or inadvisable. Intrascapene aneurisms are often associated with and part of an aneurismal dilatation of the innominate. Ligature of the third part of the subclavian and simultaneous ligature of the carotid is the recognized treatment of these conditions and is highly successful. In extrascapene aneurisms, proximal ligature is the procedure of choice. If, however, this is not feasible ligature of the first or second part of the axillary has been successful in curing some of these cases (Barkley,³ Braun⁴) Monod⁵ tied the termination of the third part of the subclavian and the common carotid and cured an aneurism of the third part of the subclavian. Gérard-Marchant⁶ successfully tied the carotid and the axillary for the cure of an aneurism occupying the whole subclavian artery. In cases of aneurisms of large extent prohibiting proximal ligature, it would seem wise to try the effects of distal ligature and in the event of failure to use other means. A case reported by Thorburn⁷ is one in point. An extensive traumatic aneurism occupying the whole left subclavian artery was treated by distal ligature of the axillary artery between the second and third portions. Pulsation returned in the sac

³ Barkley New York Med Journ, 1900

⁴ Braun Deutsche Zeitschr f Chirurgie, 1903, t lxi

⁵ Monod Bull de l'Acad de Méd de Paris 1895, p 97

⁶ Gérard-Marchant Bull de l'Acad de Med, Aout, 1901

⁷ Thorburn Brit Med Journ, 1895, vol 1, p 909



FIG 1 —Right subclavio-axillary aneurism

It extended as low as the axillary outlet. The axillary floor was depressed and bulged. The skin covering it was œdematous and thrown into creases. The radial pulse was imperceptible. The circulation in the arm was evidently much embarrassed.

Examination of the heart revealed nothing abnormal. There was no undue pulsation in the supraclavicular space. The sternal and clavicular origins of the right sternomastoid were quite prominent, but they did not stand out in relief quite so distinctly as those on the left side. Blood examination showed a leucocytosis of 28,500 and 87.3 per cent of polynuclear cells. Unfortunately, the red count and percentage of hæmoglobin are not recorded. The Wassermann reaction was positive. The urine showed nothing abnormal.

On June 23, under novocaine infiltration anæsthesia, the innominate artery was ligatured. A transverse incision about two fingers' breadths above the clavicle was carried, from the middle of the right supraclavicular space, inward across the insertion of the sternomastoid muscle to the middle line of the neck. Successive division of the sternomastoid, sternohyoid and sternothyroid gave a clear exposure of the lower portion of the carotid packet of vessels. The scalenus anticus and phrenic nerve were recognized. Following the scalenus anticus downward to the first rib, it was found to fuse with the supraclavicular swelling. Further dissection revealed the fact that the second and third parts of the subclavian artery were involved in the aneurismal sac and that the insertion of the scalenus anticus blended with the inner wall of the sac. Ligature of either the third or second parts of the subclavian artery was out of the question. Search was now made for the lower portion of the common carotid with the intention of following it down to the bifurcation of the innominate. During the search a somewhat tortuous artery was encountered just above the sternal notch. This was followed downward as a single trunk behind the sternum. Fully $\frac{1}{2}$ inch above the sternum, it bifurcated. One branch passed upward and was identified as the right common carotid. The other, evidently the first part of the subclavian, passed downward and backward and entered the lower and inner side of the aneurismal sac. The carotid trunk seemed unusually small. The subclavian was much larger. It was very short and firmly fixed, and so deeply situated that it seemed unwise to try to identify any of its branches.

The main arterial trunk, which was without doubt the innominate, was carefully cleaned and ligatured. Owing to its accessible position this was an easy task. Before the ligature was tied, the vessel was compressed and pulsation ceased in the aneurism. The ligature material used was the narrow linen tape employed

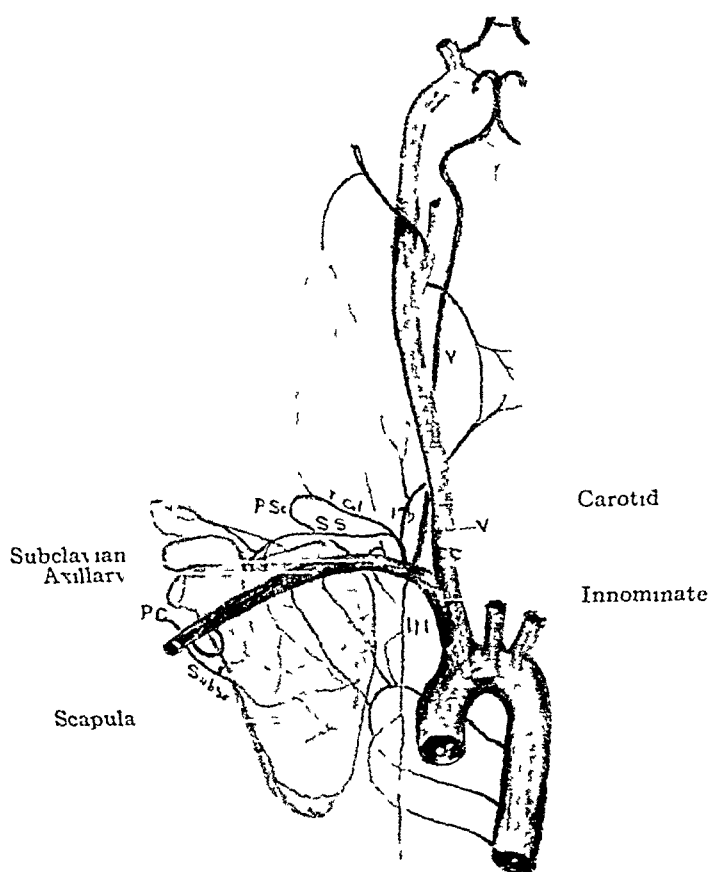


FIG. 4.—Diagram showing arterial anastomosis around the scapula. CC, common carotid (right), V, vertebral, IM, internal mammary, ITh, inferior thyroid, TCol, transversalis colli, PSc, posterior scapular, SSc, suprascapular, SubSc, subscapular, PC, posterior circumflex.

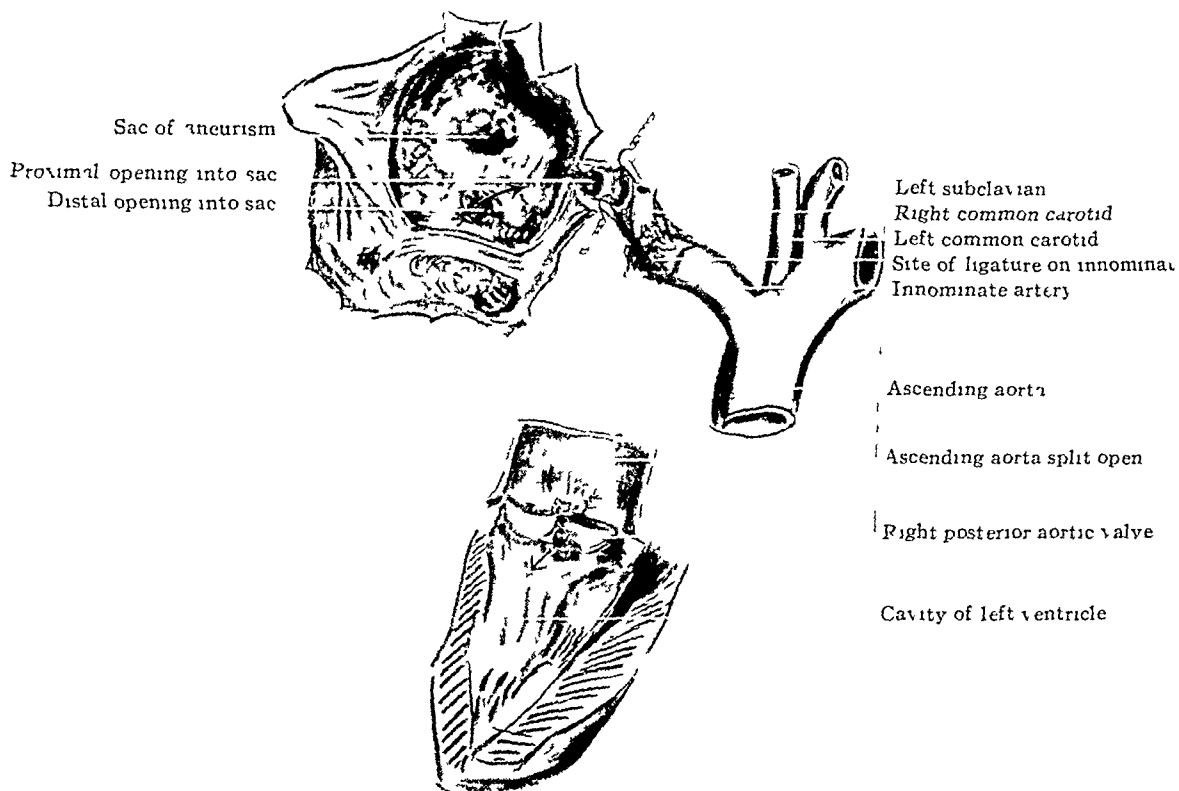


FIG 2—Shows the left ventricle of the heart laid open and two of the valves of the heart exposed viz the anterior and the right posterior. A perforation (shown by the arrow) is seen in the right posterior valve. Part of the commencement of the aorta shows several patches of atheroma.

FIG 3—Shows the remainder of the aortic arch and its branches. Near the bifurcation of the innominate artery the site of ligature is shown. The branches of the first part of the subclavian were unfortunately not dissected out. The sac of the aneurism has been emptied of clot to show the position of the distal opening of the axillary artery.

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in obstetrical practice for tying the umbilical cord (This tape goes by the name of "bobbin" and is about 1/10 inch wide.) Two of these ligatures were tied side by side and the knot finished as the stay knot (Ballance and Edmunds) The common carotid was not tied After the ligature was tied, not the slightest pulsation was visible in the aneurism

No cerebral symptoms followed the operation The arm became completely paralysed and anæsthetic almost immediately No pulsation was visible in the aneurismal sac The arm still remained cedematous The axillary swelling did not decrease in size He still complained of considerable pain in the hand and forearm

Except for complete paralysis of the upper extremity his general condition remained fair, until the middle of July, when he began to complain of pain once more in the site of the old aneurism On July 18, a soft fluctuant tumor was discovered, in the floor of the right axillary space There was still no sign of pulsation in the old aneurismal sac On July 21, aspiration revealed the presence of pus The next day, July 22, a large axillary abscess containing about a pint of blood-stained pus was opened and drained The cavity continued to drain and the patient improved and gained strength On August 1, during the night, a very profuse hemorrhage occurred from the walls of the abscess cavity. This was stopped by careful packing of the cavity No further bleeding occurred after the packing was removed and the patient continued to progress favorably, with the exception of two small carbuncles which appeared on his back Almost a month later, without any warning, the patient suddenly became unconscious This occurred at noon, on August 29 Cheyne-Stokes respiration made its appearance and he died at 4 P M on the same day (sixty-seven days after the operation)

The *autopsy* was a very complete one Careful search was made for embolism of one of the cerebral arteries, but none was found Except for marked cerebral anæmia, nothing abnormal was found in the brain

The Heart—The greater part of the cusp of the right posterior and the contiguous part of the anterior semilunar valves were deeply ulcerated (Fig 2) A large perforation was found in the right posterior valve The eroded portions of both valves were adherent to the wall of the aorta just above the sinuses of Valsalva No thrombus was found in either coronary artery and both lumina were patent The first part of the aorta showed several patches of atheroma

The innominate artery was capacious and fairly healthy It was 5½ cm long The inner coat showed no traces of atheroma From the left side, just at its commencement, the left carotid trunk took its origin About 2 cm below its bifurcation was the site of ligature Externally, this was covered

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this procedure was abandoned. The first part of the subclavian was very short and inaccessible and eminently unsuited for the application of a clamp. I do not think it advisable to apply a permanent ligature, because of the unsatisfactory results that usually follow such a procedure. If I could have controlled the circulation through it temporarily and at the same time controlled the circulation through its branches, particularly the vertebral, I should have attacked the aneurism directly by the open method. But without full control I was afraid that too much blood would reach the aneurismal sac through these branches to justify such a heroic procedure. It was a great disappointment not to be able to open the sac and turn out the clots, because such a procedure would have relieved the pressure instantly on the tissues outside the aneurismal sac, and allowed the blood to pass along the collateral channels with greater ease. I was convinced that any handling of the first part of the subclavian was unwise, because of possible permanent injury to its branches, which were necessary to carry on the collateral circulation. Ligature of the innominate seemed the only course to follow. There was no reason to fear for the life of the arm because both the vertebral artery and the common carotid were left intact, and it was confidently expected that enough blood would flow downward along these vessels to keep the arm alive. It was probably wise, in this particular instance, not to have ligatured the common carotid. The collateral circulation outside the aneurism was seriously embarrassed, and it is quite probable that the vertebral and inferior thyroid alone would have been unable to have supplied the arm with enough blood to keep it alive. The possibility of distal ligature never entered into our calculations. Only the brachial artery was accessible, and ligature of this trunk would have been fatal to the life of the arm. If the third part of the axillary artery had been accessible and a ligature could have been applied *above* the origin of the subscapular artery, a satisfactory result might have followed without imperilling to any great extent the collateral circulation.

IMMEDIATE RESULTS OF LIGATURE OF THE INNOMINATE ARTERY

The primary object of ligature of an artery is to cut off the blood current through the aneurismal sac and promote clotting in its interior. If the innominate artery alone is ligatured, there will always be a possibility of blood flowing downward along the carotid of the same side into the subclavian artery. Blood may also reach the subclavian in a reflux manner from the vertebral. A fair amount of blood will also reach it through the anastomotic channels derived from the other branches of the first part of the subclavian.

by a dense mass of scar tissue. Internally, the lumen was not completely obliterated, but admitted easily the end of a fair-sized probe. After slitting the artery up, the site of the ligature was shown by a transverse ridge, the edges of which were ragged and friable (Fig 3). In places the intima was lost, and minute ragged holes were seen which led into the substance of the arterial wall. Portions of the linen ligature could be seen through these apertures. There was no clot on the ragged edges of these small holes. They had the appearance of having been produced mechanically (postmortem) by pulling open forcibly the sides of the artery after it had been slit open.

The arteries were carefully examined on the distal side of the ligature. The carotid was quite normal. The subclavian was a little dilated. At a distance of 2 cm it passed into the consolidated mass which represented the sac of the aneurism. On sitting it up, the inner coat was found to be smooth and apparently healthy. After tunnelling the wall of the sac for 2 cm the vessel opened into the cavity of the aneurism. The margins of this opening were abrupt, irregular and crenated. The interior of the aneurismal sac was filled with consolidated clot. This was dark-colored near the opening of the artery, but white and fibrinous elsewhere. After peeling away a quantity of clot from the interior of the sac, the inner lining of the wall was examined. It was rough everywhere, and no traces of endothelial lining could be discovered. The clot was so adherent to the wall of the sac in every part and so little of it was red that there was no reason to believe that blood had been circulating through the aneurismal sac since the ligature had been placed on the innominate.

The distal opening of the axillary vessel was found after the clot had been peeled from the sac. This was situated 7 cm from the proximal opening. It was absolutely obliterated, being filled with organized clot. Three centimetres distal from the sac the axillary artery was patent. The wall of the sac was very thick and was formed by adventitious tissue, in which were incorporated pectoral muscles, axillary nerves, and at its inner aspect scalenus medius and scalenus anticus. The whole sac measured 17 cm in length and 14 cm in breadth. Its lower aspect was hollowed out by an irregular cavity consisting of numerous intercommunicating pockets which contained pus (axillary abscess). It was otherwise filled completely with clot, which was everywhere so adherent to the wall that it could only be peeled off by using great force. The aneurism was completely consolidated.

The line of treatment was finally decided upon during the development of the operation, as it was not possible to tell until the anterior scalenus muscle had been exposed whether the third or perhaps the second part of the subclavian artery could be tied or whether a ligature would have to be placed further up stream nearer the heart.

We had hoped to have been able to have controlled the circulation on the proximal side by clamping the second or third part of the subclavian, and to have completed the operation by opening the sac and performing an obliterative or reconstructive aneurismorrhaphy (Matas), as conditions allowed. Owing to the scalenus anticus being incorporated in the wall of the sac,

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blood-vessels towards the brain cease, but a reverse current starts in them toward the upper extremity which is in sore need of blood. In this manner, some of the blood circulating through the circle of Willis is diverted from the right side of the brain, and instead of passing terminally in full bore along the terminal cerebral branches of the carotid and vertebral, reaches the nervous centres in less volume. It would be much better for the cerebral circulation if this loss could be prevented, and, arguing from a theoretical stand-point, ligature of the common carotid and vertebral would benefit the cerebral circulation.

From the above facts we may conclude that ligature of the carotid serves a double purpose, viz : (1) to diminish still further the flow of blood through the aneurism and promote consolidation, (2) to prevent an excessive drain of blood from the circle of Willis and avoid cerebral anæmia. Therefore, it may be concluded safely that the practice of simultaneous ligature of the innominate and the right common carotid is founded on sound reasoning.

Status of the Operation—I have been able to find authentic references to 52 cases of ligature of the innominate artery in which there were 16 recoveries, *i e*, 30·7 per cent. The information has been gleaned mainly from three papers, one by Sheen, published in 1905, in which he collected 36 cases, another by Burns,⁸ in 1908, who added 7 more, a third by Hamann in 1914, who added 7 more. In addition I have been able to find references to one other case beside the one reported above, making two more.

As far as the histories of the cases enable us to judge, out of the 52 cases collected, there were 41 cases of spontaneous aneurism, 6 cases of traumatic aneurism, and 5 cases of wounds of the large arterial trunks. The recoveries were distributed as follows

	Cases	Recoveries
Spontaneous aneurisms	41	12
Traumatic aneurisms	6	2
Wounds of arterial trunks	5	2
	—	—
	52	16

It is interesting to note that the two recoveries in traumatic aneurisms were reported in 1906, by a Japanese surgeon, Saigo. One case was a traumatic aneurism of 40 days' duration, of the right common

⁸ Burns in his paper claims to have collected ten new cases. Two of his cases, viz by G. H. Porter and T. Annandale in table No. 4, p. 1674, had been reported previously by Sheen in his table of "cases of attempted ligature," p. 23. A third case attributed to Miles (also in table 4), I have been unable to find and have therefore not thought it wise to include it.

Under ordinary circumstances there is not much likelihood that the upper extremity will be deprived of its blood supply to a degree sufficient to jeopardize its vitality. Rather is there a fear that too much blood will flow through the aneurismal sac and that consolidation will not occur. With this possibility in view, some surgeons place a ligature on the common carotid, while others obliterate both common carotid and vertebral at the time of the primary operation on the innominate. It would appear, however, from theoretical considerations, that these additional ligatures would place the circulation of the upper extremity in greater jeopardy. If consolidation of the aneurism occurs, no blood can pass into the upper limb by the direct route (*i e*, via the subclavian artery, the aneurism and the axillary artery). It must pass by the anastomoses. A study of the anastomotic channels (Fig 4) should be made under two conditions (1) With the carotid and vertebral still patent, (2) with one or both of these arteries tied. In the *former* the first part of the subclavian remains an active part of the direct arterial system, owing to the large quantity of blood flowing backward into it along the lumina of the carotid and vertebral arteries. Blood passes freely into its branches, and, if consolidation occurs in the aneurism, the supra-scapular, possibly the posterior scapular, and the superior intercostal arteries will serve as the chief anastomotic channels to carry blood into the branches of the axillary artery below. In the *latter* condition, where one or both arteries are tied, the first part of the subclavian is partially or completely cut off from the arterial system. It is true, after ligature of both arteries, that a feeble trickle of blood may reach it as a reflux from the inferior thyroid, but there will not be enough to fill the supra-scapular which is perhaps the most important of all the anastomotic trunks. In such a case the circulation of the upper limb will be greatly imperilled, for it is hardly to be expected that in a large axillary and subclavian aneurism the anastomoses between the thoracic branches of the axillary artery and the intercostal arteries would suffice to carry enough blood to the arm. Therefore, it would appear to be a dangerous procedure to add to a ligature of the innominate, simultaneous ligature of both carotid and vertebral. One of these trunks should be left free to carry blood into the first part of the subclavian and its branches. The vertebral alone seems able to supply this want, as simultaneous ligature of the innominate and carotid have been performed many times without seriously affecting the vitality of the upper extremity.

What effect will the additional ligature of the carotid have on the cerebral circulation? Ligature of the innominate artery alone cuts off the direct flow of blood to the right side of the brain through the internal carotid and vertebral arteries. Not only does the current in these

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It will be seen that the percentage of recoveries after ligature of the innominate alone is 41·2 per cent, as against 66·6 per cent after simultaneous ligature of the innominate and carotid. Simultaneous ligature of the three trunks seems to have been very disastrous. It is probably rather unwise to draw hard and fast conclusions from the figures shown above, because so many factors enter into the causes of success and failure that cannot be gleaned from any published case. So much depends on the pathological condition of the artery tied, the state of the collateral circulation, the dexterity of the operator, the cleanliness of the operation and the condition of the patient, that statistics must be accepted with the greatest caution.

ABSTRACTS OF ALL CASES REPORTED SINCE SHEEN'S ARTICLE WAS WRITTEN

36. SHEEN, WILLIAM (1905) (*ANNALS OF SURGERY*, July, 1905) Patient admitted into Cardiff Infirmary in February, 1904. Aged forty-six years. Alcoholic but no history of venereal disease. Occupation, a laborer. Had previously served in the army.

Diagnosis Spontaneous aneurism of the right subclavian artery, mainly occupying the third part. *Operation* (March 31, 1904) An attempt was made to secure the first part of the subclavian artery through a vertical incision near the middle line. The common carotid was identified and followed downward. The pleura was wounded (?) and ligature of the first part of the subclavian abandoned. The innominate was tied with floss silk, two ligatures being used side by side (Ballance's stay knot). The common carotid was also tied. Pulsation in the aneurism ceased at once. The patient was restless for two days, but eventually made a good recovery. Pulsation returned in the aneurism on the day following the operation. Its intensity varied from time to time, but never became so forcible as before the operation. The pain down the arm and the other pressure symptoms continued. The *second operation* was performed on May 19. An attempt was made to ligature the innominate on the cardiac side of the first ligature. An alarming gush of blood caused the operation to be abandoned. The *third operation* was performed on June 2. The scalenus anticus was identified and its outer edge carefully dissected. A small healthy portion of the subclavian artery was exposed between the muscle and the upper part of the aneurism. The phrenic nerve was retracted and the outer part of the scalenus anticus was divided. Two ligatures were then placed on the artery proximal to the aneurism, one on the second part of the subclavian, the other on the third part close to the aneurism. Pulsation ceased and the patient was entirely cured.

37. GAY, G. M. (1897) (*Boston Med and Surg Journ.*, 1897, v 137, p 73) Female, aged thirty-nine years.

Diagnosis Spontaneous aneurism involving the innominate, carotid and subclavian arteries, of two years' duration. The innominate artery was tied with three braided silk ligatures placed at different levels. The wound became septic and secondary hemorrhage occurred on the thirty-second day. The common carotid artery was tied but no effect was produced on the bleeding. The patient died ten days afterwards.

carotid artery, resulting from a gunshot wound. Ligature of the innominate failed to cure the aneurism. Nine months later the aneurism was cured by excision. The other case was a traumatic aneurism of the right subclavian. Ligature of the innominate seems to have been successful, but neuralgic pains persisted. The case was eventually cured by excision of the aneurismal sac after double ligation of both subclavian artery and vein on each side of the sac.

The recoveries after wounds of arteries comprise two cases. The one reported by Lewtas (Sheen No. 28) was a wound of the subclavian, caused a month previously by the bursting of the breech of a rifle. The piece of steel was lodged above the clavicle. There had been bleeding from the wound three days before admission. When the steel was removed a profuse hemorrhage occurred. This was stopped by pressure. The innominate and carotid were tied and bleeding ceased. The other reported by Hernandez gives very meagre details. An injury was received at the origin of the right carotid which necessitated ligature of the innominate. Recovery followed.

Careful analysis of all the cases reported seems to show that simultaneous ligature of the carotid and innominate is followed by a smaller mortality than ligature of the innominate alone.

The following summary explains this in a graphic manner.

SUMMARY OF TOTAL NUMBER OF CASES

	Cases	Recoveries	Deaths
Ligature of the innominate alone	35	7	28
Ligature of the innominate and carotid simultaneously	15	9	6
Ligature of the innominate, carotid, and vertebral simultaneously	2	0	2
	—	—	—
Total	52	16	36

As a large number of these cases (21 in number) were reported before the year 1880, I have analyzed the cases published since that date, which we may presume fall in the antiseptic period.

The results are more striking even than the former.

SUMMARY OF CASES OPERATED UPON SINCE THE YEAR 1880

	Cases	Recoveries	Deaths
Ligature of the innominate alone	17	7	10
Ligature of the innominate and carotid simultaneously	12	8	4
Ligature of the innominate, carotid and vertebral simultaneously	2	0	2
	—	—	—
Total	31	15	16

LIGATURE OF THE INNOMINATE ARTERY

of the right side The operation was performed on June 16, 1900 The entire third portion of the subclavian artery was occupied by the aneurism Excision of the inner end of clavicle and sternum revealed a fusiform aneurism of the innominate in addition The innominate artery was ligatured about one inch from its origin Two ligatures of kangaroo tendon and one of braided silk were used Death occurred on the operating table

43 BURNS, W. B. (1908) (*Journ Amer Med Assn*, November 14, 1908) Male, aged twenty-seven *Diagnosis* Spontaneous aneurism occupying the third part of the right subclavian artery The hand and arm were oedematous and numb He complained of severe pain in the shoulder *Operation* (August 9, 1907) The innominate artery was exposed by the Mott incision and tied with thick braided silk (pedicle silk) at a point about one inch proximal to its bifurcation Pulsation ceased immediately and did not return The wound suppurred On August 22, a hemorrhage occurred from the wound which was controlled by packing On August 24, another small hemorrhage occurred On August 26, this was repeated. After this, convalescence was uneventful On September 30, the silk ligature was removed from the wound

44 SAIGO, K. (1906) (*Deutsche Zeitschr f Chir*, v 85, ss 577-640) Patient was a male, aged twenty-two He was shot in the neck on October 14, 1904 An aneurism developed in the common carotid artery On November 23, 1904, the operation was performed After resection of the inner end of the clavicle and part of the sternum, the innominate artery was tied The aneurism reappeared On August 11, 1905, the common carotid artery was tied above and below the aneurism, which was then resected Cure

45 SAIGO, K. (1906) (*Deutsche Zeitschr f Chir*, v 85, ss 557-640) Case of a male, aged twenty-five years Shot above the right clavicle on March 5, 1905 A traumatic aneurism developed On April 6, 1905, the innominate artery was ligatured in two places and divided between the ligatures Aneurism was not cured and pains continued On August 4, 1905, the aneurism was excised after ligature of both subclavian artery and vein, proximally, and distally Recovery

46 MYERS, SIR THOMAS (1907) (*Dublin Journ Med Sci*, v 124, pp 474, 475): Case of a male, aged twenty-nine *Diagnosis* Spontaneous aneurism of the right subclavian artery *Operation* Ligature of the innominate artery and simultaneous double ligature of the common carotid with division of the trunk Bleeding occurred into the wound ten days after operation The bleeding vessel (not identified) was ligatured Repeated hemorrhage, suppuration Death one month after the operation Autopsy showed that hemorrhage was from carotid artery

47. SARGENT, P. (1911) (*Lancet, Lond*, May 16, 1911, p 120). Woman, aged forty-seven *Diagnosis* Spontaneous aneurism of the first part of the right subclavian artery or of the innominate at its bifurcation *Operation* (September 14, 1909) After removal of the greater part of the right half of the manubrium sterni and part of the right first costal cartilage, the innominate artery was exposed without difficulty. The ligature consisted of floss silk tied in a "stay" knot The common carotid was also tied at the level of the cricoid cartilage, No 2 braided silk being used Pulsation in the aneurism ceased at once No

38 HARTE, RICHARD H (1897) (*ANNALS OF SURGERY*, Philadelphia, 1897, v xxvi, p 488) Male, aged twenty-six years Patient had received a pistol wound of the neck, the bullet entering about one inch above the inner end of the left clavicle There were evidences of injury of the fifth cervical nerve The bullet was located on the right side of the neck in front of the cervical vertebrae The bullet was removed by an incision along the posterior border of the right sternomastoid It lay alongside the oesophagus and behind the origin of the right common carotid artery On the third day, swallowed fluids regurgitated through the wound On the eleventh day, bleeding occurred which was easily controlled Two days afterwards severe hemorrhage occurred A search was made for the bleeding point The opening appeared to be on the posterior side of the right common carotid A ligature was placed on the carotid proximal to this apparent opening but the bleeding still continued The clavicle was dislocated and the innominate searched for Before ligating this vessel another ligature was placed on the carotid close to its origin This stopped the bleeding Ten days later another hemorrhage occurred The innominate was exposed and ligatured just before it bifurcated The carotid and subclavian were also ligatured The patient died in a few hours (The position of the ligature placed on the carotid and subclavian in the last operation is not clear The account of the postmortem examination does not give any information as to the blood-vessel originally wounded)

39 MOYNIHAN, B G A (1898) (*ANNALS OF SURGERY*, Philadelphia, 1898, vol xxviii, p 1) Male, aged thirty-one years Diagnosis was spontaneous aneurism of the third part of the subclavian artery On December 8, 1897, the aneurismal sac was excised This was accomplished apparently without any injury to the subclavian vein To facilitate the operation, the clavicle was divided in two places and the middle half thrown down Unfortunately, the wound became infected On December 20, there was an escape of an ounce of blood A suppurating axillary gland was opened on January 9 Afterwards the case progressed favorably, until February 6 On this day a hemorrhage occurred under the flap raised in the original operation Bleeding was checked by a pad and bandage On February 8, a fresh hemorrhage occurred Exploration of the subclavian triangle revealed a large clot of blood On clearing this away, a terrific hemorrhage resulted The innominate and carotid were tied with silk ligatures Death occurred in about an hour The postmortem revealed a rupture of a second aneurism which existed on the posterior wall of the first part of the subclavian, about one inch from the end of the ligatured vessel

40 SCHUMPERT, T E (1898) (*New York Med Record*, September 3, 1898, p 337) Female, aged forty-two years *Diagnosis* A spontaneous aneurism arising probably from the termination of the innominate A braided silk ligature, No 8, was tied around the innominate artery proximal to the aneurism The patient died of cerebral anæmia on the ninth day after the operation

41 HERNANDEZ, ALBERTO (1900) (*Wien med Blatt*, 1900, v xxiii, No 35, p 559) For an injury at the origin of the right common carotid the innominate artery was ligatured with a successful result

42 DE LAUF, S P (1901) (*Phila Med Jour*, 1901, v vii, January 26, p 171) Male, aged fifty-eight years *Diagnosis* Subclavio-axillary aneurism

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and treat the aneurism by the Matas method While cleaning the innominate, a hole was accidentally torn in its outer side The vessel was then tied below this with soft, thick silk ligature The right common carotid was tied with catgut A piece of fascia lata taken from the thigh was wrapped around the ligatured vessels After the operation pulsation ceased and the agonizing pain had gone There was complete anæsthesia and paralysis of the arm This gradually passed away

52 THOMPSON, JAMES E (1914) Case reported in this communication

cerebral symptoms were noticed On the sixth day slight pulsation reappear in the sac On the ninth day pulsation disappeared On the tenth day weakness in the left arm and face were noticed for the first time No loss of power was noticed in the left leg The weakness soon passed away The patient was seen in June, 1910, and was in fine condition No weakness was found in the arm or face or leg, and no pulsation was found in the aneurism She remained well until the early part of 1911, when she died of chronic nephritis and pneumonia The pathological specimen was obtained and it showed complete obliteration of the innominate and carotid between the ligatures and obliteration of the first part of the subclavian almost as far out as the origin of the vertebral

48 BALLANCE, C A (1912) (*Proc Roy Soc of Med*, Lond Clin Sec vol v, p 99) Case of a male, aged forty-three *Diagnosis* Spontaneous aneurism of eighteen months duration of the right subclavian artery *Operation* Ligature of the innominate artery with two strands of kangaroo tendon During operation it was found that the aneurism covered the first part of the subclavian which was inaccessible Recovery

49 BALLANCE, C A (1912) (*Proc Roy Soc of Med*, Lond Clin Sec vol v, p 99) He mentioned, during the discussion of the case above reported another which came under his care two years previously, suffering from a large right subclavian aneurism It suddenly began to extend Part of the manubrium was resected and the right clavicle and first and second ribs were divided The aneurism overlapped the innominate artery, which, however, was ligature Pulsation in the aneurism ceased immediately While getting ready to close the wound, the aneurismal sac burst and there was a sudden gush of blood A finger was passed into the sac and the hole plugged Finally the sac was plugged with gauze The patient died on the following day

50 HAMANN, CARL A (1914) (*ANNALS OF SURGERY*, June, 1914, p 962) Woman, aged sixty-eight years *Diagnosis* Spontaneous aneurism of the third part of the right subclavian artery No disturbance of circulation except pain and paræsthesia First treatment consisted of the insertion of 8 inches of fine silver wire into the sac No improvement followed Operation was performed on February 10, 1913 The aneurism was exposed and was found to involve mainly the third part of the subclavian, and to encroach also on the second and part of the first portion of the artery The innominate was exposed after resection of two inches of the inner end of the clavicle A heavy braided double silver ligature was placed about half an inch below the bifurcation and tied with ordinary surgical knot The common carotid was tied about an inch above its origin with No 2 chromicized catgut No unfavorable circulatory troubles manifested their appearance after the operation The wound healed by first intention The sac became consolidated and firm Cure was complete thirteen months later

51 MORRISON, RUTHERFORD (1914) (*Brit Journ Surgery*, April, 1914, 725) Male, aged fifty-one years *Diagnosis* Spontaneous aneurism of the third part of the right subclavian artery There was excruciating pain in the shoulder with numbness and loss of sensation down the right arm There was œdema and venous engorgement of the arm and forearm *Operation* (July 20, 1912) The intention was to put a temporary ligature on the innominate



FIG 1 —Experiment No 1



No 3

FIG 2 —Experiments No 3 and No 4

No 4

TRANSPLANTATION OF ENTIRE BONES WITH THEIR JOINT SURFACES *

BY A. BRUCE GILL, M D
OF PHILADELPHIA, PA

THE following experiments in bone transplantation were undertaken to determine whether or not it is possible to secure the healing in entire bones with their articular surfaces, and whether or not such bones, if they do become healed in, will remain alive and unabsorbed and, finally, to observe any other conditions that may have a bearing upon the subject of bone transplantation in general

Full-grown dogs were operated upon under complete surgical anaesthesia by ether. The second long metatarsal bone was excised in the front paws and each one was implanted in the opposite paw. The ends of the bone were held in position by chromic catgut sutures. The tendons and fascia were sutured over it with interrupted sutures of silk floss. Asepsis was attempted by shaving the paws and painting the skin with tincture of iodine and by clamping the margin of the incision to sterile towels. After the incision was closed it was painted with tincture of iodine. No dressings were applied and the dogs were permitted to walk about. Thus they usually did on the day following operation without any evidence of pain.

Experiment No 1—Operation January 30, 1914. Periosteum scraped from the bone implanted in the right paw. Both skin wounds broke down a few days after the operation. The left paw was entirely healed on February 18, but the right presented a discharging sinus. On March 9, the exposed metatarsal was removed from the right paw under ether anaesthesia. April 4, both paws healed. The dog walks and runs on both feet without a limp. October 16, dog killed. X-ray picture of paws shows the metatarsal present in left paw. Marrow canal narrowed and irregular but persistent throughout the length of the bone except at proximal end, which shows evidence of the suppuration that occurred after the operation. The metatarsophalangeal joint is apparently normal. In the right paw only about one-half of the distal extremity of the transplanted bone remains.

Experiment No 2—Operation February 19, 1914. February 24, both wounds wide open to the fascia. February 26, dog killed, as a part of the left transplant was exposed. The other half of it was found to be firmly embedded in granulation tissue which was firmly adherent to the bone except at the joints. The other transplant was completely embedded in granulation tissue which was

* Read before the Philadelphia Academy of Surgery, February 1, 1915



FIG 5 —Photograph of section of paw



FIG 6 —Photograph of section of paw mounted in celloidin

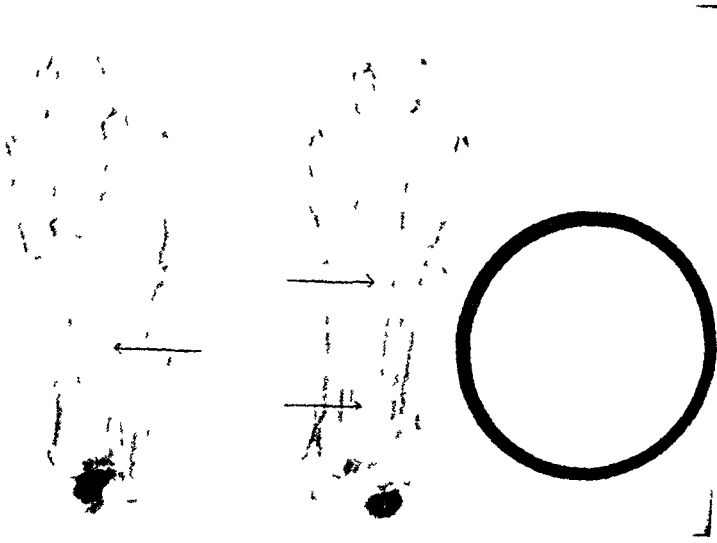


FIG 3 —Experiment No 5



FIG 4 —Experiment No 6

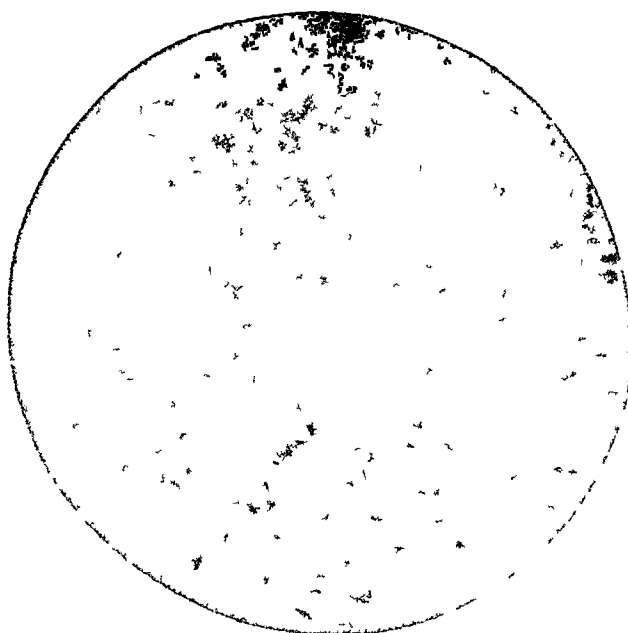


FIG 9 —Microphotograph of transplanted bone, showing joint cartilage above and bone below
Cells of both are well stained



FIG 7 —Photograph of section of paw



FIG 8 —Photograph of section of paw, mounted in celloidin

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firmly adherent to the bone except at the joints. The bone was torn out with considerable force, and soft tissue remained clinging to it.

Experiment No 3—Operation February 25, 1914. One metatarsal broken in removal and not implanted. March 17, small sinus present. Dog walks without limp. May 6, small persistent sinus. June 15, healed. October 16, dog killed. X-ray shows transplanted bone present and apparently normal, except for slight irregularity in proximal end. Both joints apparently normal.

Experiment No 4—Operation February 26, 1914. March 9, skin wounds open to the fascia, right discharging pus. March 17, almost healed. Dog has distemper. April 29, small sinus in right paw, left remains healed. May 6, right paw healed. October 16, dog killed. X-ray of left paw. Transplanted bone all absorbed except small distal fragment. Right paw the bone is present, marrow cavity very narrow, proximal half of bone thick and irregular. Distal joint normal, proximal joint obscure. The other metatarsals and the tarsal bones also present evidence of the suppurative process.

Experiment No 5—Operation March 18, 1914. March 25, wounds both open to the fascia. April 2, wounds healed above and open below. April 29, suppuration in both paws. October 9, healed. October 23, dog killed. X-ray of left paw. Transplanted bone shows marked evidence of the long suppuration, thickened, irregular, proximal end absorbed for about one-fourth inch. Right paw. Bone much distorted, proximal ends of two other metatarsals also slightly involved. Distal joint good.

Experiment No 6—Operation March 19, 1914. March 25, left is healed, did not break down. Right is open below. April 2, both healed, no lameness. October 23, dog killed. X-ray of left paw. Transplanted bones present, a little thinner than normal, proximal extremity a little irregular, otherwise like other metatarsals, dislocation of distal joint. Right paw. Transplanted bone apparently normal throughout.

Summary—Eleven bones were transplanted. One dog was killed a week after operation, before healing in of the bones had occurred, and in another dog one transplant was removed under ether. The remaining eight transplants healed in after more or less suppuration of all wounds but one. The dogs were killed from seven to eight and one-half months after operation. One of the eight healed-in transplants was found to be almost all absorbed. Another is badly distorted and a second moderately changed as a result of osteomyelitis following operation, but they appear to be serving their function and they present evidence of new bone formation. The remaining five transplanted bones are practically normal in appearance. The articular ends of the bones are apparently normal and the joints have perfect function except in those cases where the end of the bone was destroyed by the suppurative process.

Microscopic examination of the transplanted bones that healed in with little or no suppuration of the wounds shows no evidence of dead bone anywhere. The bone cells as well as the cells lining the marrow

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a transplanted bone is only osteoconductive and that it must contact with fresh living bone is absolutely inapplicable to these experiments

The metaplasia theory of bone regeneration from the surrounding connective tissue cells is maintained by Baschkirzew and Petrow, whose views, based on animal experimentation and clinical observations, are entitled to some consideration, if only to expose their fallacy. They state that the majority of bone transplants soon die although a few stronger or better nourished ones may live a long time, until they also die of exhaustion. Some few heal in and regenerate new bone. Young connective tissue cells are the chief factor in the regeneration of new bone in a transplant which is imbedded in muscle. They penetrate into the vascular and the Haversian canals and are converted into osteoblasts and bone cells. The transplanted periosteum and endosteum become in part necrotic, while the remaining part is possibly capable of bone regeneration. But the persistence of such new bone is questionable and its differentiation from the bone which grows from the connective tissue cells is often impossible. The preservation of the periosteum is not essential to the life of the transplant, but it evidently is useful in causing more rapid union between the transplant and the surrounding tissues, in hindering resorption of the transplant, and in giving the first impulse to new bone formation.

This view of metaplasia does not agree with the views of most other investigators of this subject. Nor, if pushed to the limit, does it seem tenable. If the entire transplant has died and if later we find the transplant to be alive, then it is necessary to suppose that all its parts, periosteum, marrow, endosteum, bony tissue, have been regenerated from young connective tissue cells from the surrounding structures. But if these tissue cells are capable of such metaplasia, why do they not perform such function at all times, why do they wait until a dead transplant is thrust into their midst, or why do they not do it when a piece of decalcified bone or other porous substance is implanted? It becomes necessary to suppose that in some unaccountable manner the dying transplant stimulates the metaplasia. The same process must necessarily occur in every simple comminuted fracture. And all this theory in the face of the fact that bone contains within itself the elements necessary to its growth and regeneration. Why then should it borrow from the outside?

As a matter of fact, Baschkirzew and Petrow do not push their theory to its rational conclusion. They admit that certain parts of the transplant do regenerate new bone, but say that such bone often cannot be differentiated from the bone which grows from the connective tissue

cavity and the cells of the periosteum are well stained. If there was necrosis of the transplanted bone, the necrotic part has all been absorbed and replaced. The joint cartilage also appears normal.

The operations were performed by the writer without assistance. This rendered it necessary to fasten the paws of the dogs securely to blocks of wood. The straps caused venous constriction which prevented complete hæmostasis and delayed the operations. These conditions probably caused the breaking down of the wounds and the subsequent suppuration. In experiment No. 6 this condition of venous constriction was avoided and the one paw healed by first intention and the other healed promptly after it had opened up slightly. I believe that practically all cases could be operated upon with primary union under favorable conditions and consequent healing in of all transplanted bones.

The fact that so many of them healed in under unfavorable conditions and in the presence of infection shows the marked resistance of the transplant. The articular ends of the bones and the joint cartilage show an equal ability with the remaining portion to maintain their life and resist infection. In these experiments the joints emerged from their trials in fully as good condition as the bones proper, and should follow that the transplantation of half-joints and entire joints should present no greater difficulty or uncertainty than the simple transplantation of bones of equal size.

The fact that the dogs went about on their paws almost immediately following the operation does not necessarily affect the transplanted bone adversely. To the contrary, the functioning of the transplant may be a favorable factor in its life and regeneration.

These experiments would seem, therefore, to indicate that the smaller long bones with their articular surfaces are readily transplantable in the dog under unfavorable conditions, and that the joints are re-established and preserved thereafter.

In the successful transplantations the bones are found at the end of seven to eight and one-half months to be normal in outline and structure, to be living and to show no evidence of necrosis or absorption of any of their parts, in short, to be indistinguishable from normal bone. They have not been in contact with other bones except through their articular surfaces. We must therefore conclude either that the transplanted bone has retained life in itself or that it has been completely regenerated in all of its parts by a process of metaplasia of cells derived from the surrounding soft tissue. Murphy's theory that

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Likewise, there is some confusion in the use of the term bone graft. In some cases it means all the parts of a bone from periosteum to marrow, and again it means only the compact bony tissue, and frequently its meaning is not stated or indicated. When Gallie says a bone graft always dies, he is speaking of one probably without periosteum and with little or no endosteum.

In the second place the views of certain writers have been somewhat modified and we must consult their most recent utterances. Axhausen at first stated that bone regeneration occurs only from the periosteum, but he now maintains that the marrow, or endosteum, and joint cartilage are likewise transplantable, *i e*, they remain living and are capable of regeneration. Albee at first stated that a bone graft without periosteum is as good as one with it, but now he is careful to retain both periosteum and endosteum in the graft.

And, finally, most authors have disregarded Roux's law of functional adaptation. The final result of a bone transplanted into soft tissues where it bears no weight and serves no other function may be entirely different from that of a bone placed where it will serve a mechanical function. Function stimulates growth and regeneration both in normal and in transplanted tissues.

Let us now examine very briefly the various theories of bone transplantation. The old theory of Barth, recently restated by Murphy and others, that a bone transplant always dies and is absorbed and is replaced, if it be replaced, by bone from the recipient or contacting bone, must be definitely rejected. It is based on insufficient and defective evidence and is directly disproved by a large mass of experiment by Axhausen, Ollier, Albee, McWilliams, Nicholls, Phemister, Cotton and Loder, Hass, Lexer, Mayer and Wehner, Tomita, Trinci and others. In the experiments of the writer the transplanted bones did not contact with other bone except through their joint surfaces, which, of course, effectively prevent osteoconduction. The recent study of Gallie need not be considered as corroborative of the above theory, as it merely shows that some bone grafts without periosteum and with little or no endosteum may die and be replaced by bone from the recipient bone.

Macewen believes that the bone cells of the transplant occupying the lacunæ of the bony substance itself are the active agents in the life and regeneration of a transplant, and that the periosteum is only a limiting membrane and takes no part in osteogenesis. He makes the mistake of pre-enting no microscopical evidence and of entirely neglecting the consideration of the cambium layer of the periosteum. His experi-

cells. How then can they differentiate the latter from the former? Finally, the thorough microscopic studies of Phemister, Mayer and Wehner and many others show that certain parts of the transplant are osteogenetic. The latter investigators give careful consideration to Baschkirzew and Petrow's theory and point out the errors in their experiments in not excluding bone derived from the osteogenetic layer of the periosteum and from adjacent Haversian canals.

All the evidence and all the weight of authority is against the view of regeneration by metaplasia. We must conclude that a transplanted bone retains life in itself and is capable of its own regeneration as far as is necessary.

For clinical purposes this is all that is necessary to be certain of in the transplantation of bones. And yet it may be of value to know, for example, whether or not we should remove the periosteum from the transplant. This opens up to us the entire question of the rôle played by each part of a bone transplant, what parts live and what parts die, what parts regenerate bone and what do not.

At first view one is confused by the opposing views of such men as Barth and Murphy, Axhausen, Macewen, and Baschkirzew and Petro with their numerous followers or predecessors. Their views are often diametrically opposed and they cannot all be right. But much of the confusion will disappear on careful study and comparison of the various statements and theories, and I think we are able at the present time to arrive at conclusions fairly close to the truth.

In the first place, certain words, such as periosteum, marrow, bone graft, do not have the same meaning and content to all writers on the subject. When Macewen and others state that they have removed the periosteum in certain experiments they mean that part of the periosteum which is easily stripped from the shaft of the bone. But May and Wehner and various histologists have shown that the cambium, osteogenetic layer of the periosteum, which Macewen ignores or denies to exist, is applied so closely to the bone and so penetrates into the bony canals, particularly at the cancellous ends of the long bones, that it cannot all be removed even with a rasp. This fact must vitiate practically all such experiments unless it has been microscopically proved that there has been no osteogenetic layer of the periosteum left on the transplant.

Again, when Axhausen speaks of bone regeneration from marrow or medulla, he means regeneration from the endosteum which lines the marrow cavity and the Haversian canals. Like the periosteum it too cannot be completely stripped from the bone.

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Axhausen's views appear, in the main, to be fairly correct according to a large number of observers, but probably he falls a little short of the truth

I think it is no longer to be questioned that the inner, or osteogenetic, layer of the periosteum is of prime importance in the life and regeneration of a bone graft. Histologists have long taught that the periosteum is the main factor in the growth of the bone. Nicholls shows that periosteum will regenerate complete shafts of bones that have been destroyed or excised. Oechsner and others confirm this work. Ollier in 1859 showed that bone is regenerated from the periosteum chiefly and in smaller part from the cellular elements of the marrow and the Haversian canals. McWilliams says over reliance must be placed upon the periosteum.

Hass' experiments emphasize the value of this tissue and Lexer adds the weight of his authority in saying that the bony tissue of a transplant is gradually absorbed and is replaced by bone formed from the periosteum chiefly and from the medulla in part, and that the periosteum also aids in cementing the graft to the wound and in stimulating capillary invasion and early nutrition.

Jokoi produced new bone in six out of ten cases by injecting emulsion of periosteum of tibiae of young dogs beneath the skin or into the muscles.

Trinci showed that transplanted periosteum is capable of early bone regeneration.

Tomita states that new growth is from the inner layer of the periosteum and from the marrow cells.

Phemister and Mayer and Wehner confirm the periosteal osteogenesis by very painstaking and thorough experiments. In all of Murphy's published cases the periosteum was retained in whole or in part, although he states that the periosteum is not osteogenetic except when it carries osteoblasts on its inner surface.

If we view this entire process of the life and regeneration of a bone graft from the embryonal and histological point of view it seems very simple and reconciles the observations of many experimenters. The position of many of the bones is indicated in the embryo by the deposition of embryonal cartilage. But this cartilage is never directly converted into bone. It is replaced by bone formed from the osteogenetic layer of the periosteum. This layer sends bud-like extensions into the ossified centres, and proceeds to the formation of true bone. The lining of the marrow cavities, in other words the endosteum, the lining of the Haversian canals, and the external covering of the bone, the

ments are all open to a misunderstanding because he does not exclude the possibility of bone formation from this structure, nor, moreover from the endosteum and the lining of the Haversian canals. It would appear from the work of Axhausen, Phemister, McWilliams, Maye and Wehner, and others that part of the bony substance of a transplant may live indefinitely although most of it soon dies, and it seems even possible that there may be regeneration from some of the bone cells which receive early and sufficient nutrition after the transplantation. Therefore, Macewen may have been partly correct in stating that the bony substance including Haversian canals lives and regenerates. But such regeneration must be far less than he supposed it to be, as it is now proved unquestionably that the preponderating part of regeneration is from the periosteum and the endosteum.

McWilliams' experiments show the great value of the periosteum to the life and regeneration of the graft, in that he records 100 per cent of successful transplantations with the periosteum, against 48 per cent without it, but he is content to ascribe this to the influence of the periosteum in maintaining the nutrition of the graft. He fails to recognize the importance of the cambium layer of the periosteum although he states that periosteum transplanted into soft tissues may produce new bone. And his experiments with transplants free of periosteum are open to the same criticism as most similar experiments that frequently all the osteogenetic layer is not removed. Nor is any mention made of the endosteum, although it seems to have been present in many or all of his cases. In my judgment his studies do not support the view of Macewen that the adult bone cells of the graft are the active element in its life and regeneration, and he directly contradicts himself as to the importance of the periosteum.

The metaplasia theory of Baschkirzew and Petrow has already been discussed.

There remains a consideration of Axhausen's teachings and an attempt to arrive at a true understanding of what occurs after bone is transplanted.

Axhausen, in brief, states that transplanted bone cells at first remain unchanged during an indefinite stage, and that then some cells die while others continue to live. Eventually all bone cells die and the bony tissue is replaced by regeneration chiefly from the periosteum and secondarily from the marrow. Bone tissue histologically is not transplantable. Joint cartilage, however, is transplantable both histologically and clinically, and epiphyseal cartilage is to a limited degree clinically.

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nutritive supply is reestablished naturally can continue their life and function. Such cells probably are those which are the more resistant in themselves and which receive earliest a fresh supply of nutriment. This may reach them from the tissue juices that surround the transplant or from the blood-vessels that are reestablished in it. The cells of the transplant lying near its surface therefore would have the best opportunity for maintaining life. And the smaller the transplant, the larger is its surface in relation to its mass, and the greater is the chance for the life cells in the transplant. Macewen's observations have confirmed this. Furthermore, the cells lying along the vascular channels would have a better chance than those lying in the lacunæ of the compact bone. And the very tissue that does line the outer and inner surfaces of the bone and the Haversian canals is the osteoblastic tissue, composed of young connective tissue cells, the osteoblasts, which are just waiting for the opportunity to exercise their especial function. The adult bone cells are imprisoned in hard compact bone and are doomed to death in large part. Even if some of them do survive and live for a long time, is it their function to form new bone to take the place of that which dies?

In practically every live bone transplant, therefore, there are osteoblasts, whether in the inner layer of the periosteum which closely lines the bone and sends numerous fingers into all the canals that open on the surface and which cannot be entirely removed by stripping off the periosteum macroscopically, or whether in the endosteum of the medulla, or whether in the Haversian canals, which are simply prolongations of the medulla. Many of these osteoblasts must be favorably situated to receive nutriment, and they stand as good a chance for the preservation of life and function as any transplanted tissues ever can. Therefore Macewen can strip off periosteum in whole or in part and the osteoblasts of the medulla and Haversian canals will remain, Cotton and Loder can maintain the prime importance of endosteal proliferation, while Nicholls and Axhausen and many others can secure bone growth from the periosteum alone. But if the graft contains all three portions of osteoblastic tissue, its chances of life and development must surely be multiplied. Therefore McWilliams secures 100 per cent of successes with the periosteum included, to only 48 per cent without it. When Mayer and Wehner have rigidly excluded with metal caps the ingrowth of the periosteum on the surface of compact bone they have found no bone regeneration from the bone cells. Such adult bone cells probably are not capable of bone regeneration, they are no longer osteoblastic. But I am not sure that we should yet accept this state-

osteogenetic layer of the periosteum, are all one and the same thing. They are continuous at least for a time and have been derived from the periosteum. This internal and external lining is a connective tissue and its young cells are only specialized connective tissue cells called osteoblasts. All bone is formed through the agency of these cells. Some of them become imprisoned by the deposition of lime salts and separated from their fellows and they are then called bone cells. These are simply adult imprisoned osteoblasts.

The remaining bones of the skeleton that are not developed in embryonal cartilage are formed directly from the osteogenetic layer of the periosteum.

When the bones of the skeleton have attained their full growth the osteoblasts of the periosteum, the Haversian canals, and the endosteum cease their activity in large part. Piersol states that "after the cessation of peripheral growth and the completion of the investing layer of compact substance, the osteogenetic layer of the periosteum becomes more condensed and less rich in cellular elements, retaining, however, an intimate connection with the last-formed subjacent bone by means of the vascular processes of its tissue, which are in continuity with the marrow-tissue, within the intra-osseous canals.

"In addition to being the most important structure for the nutrition of the bone, on account of the blood-vessels which it supports, the periosteum responds to demands for the production of new osseous tissue, whether for renewed growth or repair, and again becomes active as a bone forming tissue, its elements assuming the rôle of osteoblasts in imitation of their predecessors."

Does not this render the entire matter clear at once? Osteoblasts are present in the internal and external lining of bone and in the canals that partially connect these two linings which are thus essentially one and the same tissue. In adult bones these osteoblasts are reduced in number and are comparatively quiescent, but they are ready to respond to any demand made upon them for renewed growth or repair.

When a piece of bone or a whole bone is transplanted it is temporarily deprived of its blood supply. But this does not necessarily mean the death of all the elements of the transplant. It would appear that in the transplantation of animal tissues the more highly specialized elements are less resistant to injury or deprivation of nourishment. Probably in bone the adult bone cell is less resistant than the young connective tissue cell, for example. Now as soon as the transplant is placed in its new position a process of re-vascularization commences. Those cells of the transplant which retain life until their source

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Goebel reports the successful transplantation of the proximal phalanx of the second toe to replace the proximal phalanx of the fourth finger which was removed for enchondroma. Full motion finally resulted in all the joints of the finger. A piece of cartilage from a rib was used to replace the phalanx of the toe. The X-ray showed that at the time the case was reported the cartilage had not been transformed into bone.

Katzenstein reports the implantation of the phalanx of the great toe to replace the metacarpal bone of the thumb which was removed because of tuberculosis.

Galeazzi transplanted a metatarsal bone for a metacarpal which had been removed for neoplasm. There was good function after seven years.

Sievers also transplanted a phalanx to take the place of the middle phalanx of the ring finger removed for giant-celled sarcoma.

Wolff reports a successful similar case.

Lexer in 1907 transplanted a phalanx obtained from an amputated limb.

(8) Half joints are clinically transplantable. Lexer, Kuttner, Rosing, Wolff, Enderlen, Perthes, von Haberer, Walther, and De Gouvea, have reported successful cases.

(9) Whole joints have been successfully transplanted. Lexer has had under observation for six years a knee-joint in which motion and function are perfectly free and satisfactory, although the joint shows under the X-ray certain changes similar to those found in arthritis deformans.

Goebel and Eloesser have reported each a case of implantation of a toe-joint with unopened capsule to replace a finger-joint. A big difficulty in the transplantation of large joints is in the securing of suitable material. Lexer has discarded material obtained from the cadaver and now uses that obtained from freshly amputated limbs. Buchmann has transplanted the first metatarso-phalangeal articulation into the elbow-joint in two cases.

It has not yet been demonstrated, to my knowledge, that a small entire joint can be substituted for a larger one and grow in size to meet the necessities of the joint. It may be possible that the law of functional adaptation would apply even here.

In conclusion I wish to express my gratitude to Dr. J. E. Sweet for permission to carry out these experiments in the Laboratory of Surgical Research of the University of Pennsylvania and for many helpful suggestions in conducting them.

ment as the final truth in all circumstances. Possibly even adult bone cells may revert to their original function under favorable or exceptional conditions.

And, finally, why need we adopt the metaplasia theory of Basch and Petrow when we have right at hand in the transplant the young connective tissue cells that have been formed and have generations been accustomed to do just this one thing, regenerate bone?

McWilliams and Phemister in particular have dwelt upon the importance of an early and effective blood supply to the transplant. As the latter has well presented the importance of Roux's law in determining its ultimate fate. If it is in a position where bone is necessary to the welfare of the organism the transplant will survive and develop to a size necessary to its function. If it is in a useless position it will soon cease its growth and will probably be ultimately absorbed.

CONCLUSIONS

Certain conclusions which are of practical clinical value in surgery are readily drawn from the above experiments and discussion.

(1) Bone is only a particular form of connective tissue and readily transplantable.

(2) It contains within itself all the elements necessary to its function, and regeneration provided it receives sufficient nourishment.

(3) Periosteum, medulla, and bony tissue should all be included in the graft.

(4) After transplantation the bone grows and moulds itself to perform its function efficiently.

(5) As early performance of function as is consistent with fixation in its new position is of great advantage.

(6) A mild infection is not necessarily fatal to the graft.

(7) Transplantation of long bones with their joint surfaces is clinically possible. The inclusion of cartilage and joint surface in the graft adds to the difficulty of the transplantation. While this statement is particularly true of the smaller bones, yet there seems to be no reason why as large a bone may not be transplanted with its joint surfaces as may be transplanted without such surfaces. Bier reported a large piece of tibia used to replace almost the entire shaft of the humerus, which has been under observation for 15 years. In the case of a large bone should be transplanted it might be well to remove a portion of its shaft longitudinally in order to permit the ready access of blood supply to the medulla.

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Technic—The part was shaved or the hair was removed with a solution of sodium sulphide. The skin was washed with green soap and water, then with alcohol followed by ether. After the skin was thoroughly dry it was painted with tincture of iodine, 2.5 per cent. The iodine solution was also occasionally used in the open wounds, and after suture of the skin. Ether anaesthesia was used in each experiment. Fine black silk was the ligature and suture material used throughout. The wounds were closed in layers wherever possible. Collodion and gauze dressings were applied when necessary. Unless otherwise stated the healing will be understood as *per primam*. Landmark sutures were used when periosteum or bone was placed in the soft parts. The results were controlled by X-ray and microscopic examination.³

In these experiments, except where definitely specified to the contrary, care was taken not to remove any particles of bone with the periosteum. This was accomplished by outlining the periosteal flap down to the bone with a scalpel, and starting it away from the bone with a blunt instrument. Then by means of a small, very firm gauze pad, grasped in an artery clamp, the periosteum was removed without disturbing the surface of the bone.

Microscopic examination shows that the periosteum with the greater part of the *underlying osteoblasts* may be removed in this way.

For convenience in comparing the results we have divided the experiments into groups.

GROUP I THE TRANSPLANTATION OF FREE FLAPS OF PERIOSTEUM

A THE TRANSPLANTATION OF FREE PERIOSTEUM WITHOUT BONE PARTICLES INTO THE MUSCLE OR SUBCUTANEOUS TISSUE OF THE SAME ANIMAL —*Summary*—Twenty-one experiments were done, 16 on dogs and 5 on young rabbits. The flaps of periosteum varied in size from that of the entire femur to an area 1 cm. wide from the circumference of the radius. In 1 experiment the periosteum from a section of fibula, 1.6 cm. long, was turned inside out in stripping it from the bone, thus exposing the surface next to the bone. In 6 experiments the periosteum was placed in the subcutaneous tissue, and in 15 in the muscle tissue. The periosteum was spread out and sutured in position in 7 experiments, and in 14 it was bunched. The specimens were examined 8, 14, 15, 19, 30, 31, 35, 78, 94, 95, 104, 113, and 133 days after opera-

THE OSTEOGENIC POWER OF PERIOSTEUM. WITH A NOTE ON BONE TRANSPLANTATION

AN EXPERIMENTAL STUDY *

BY JOHN STAIGE DAVIS, M D.
OF BALTIMORE

AND

JOHN A HUNNICUTT, M D.
OF ATHENS, GA

(From the Hunterian Laboratory of Experimental Surgery, the Johns Hopkins University)

INTRODUCTION

THE appearance of Macewen's monograph¹ caused considerable discussion among those interested in the growth of bone. His experiments seemed to show that periosteum was not a bone producing tissue, but that its function was simply that of a limiting membrane. This, of course, was not in accordance with the principles accepted for many years, and it was difficult to adjust ourselves to his ideas without first hand experimental proof.

The literature on this subject has been fully commented on in a number of recent experimental and clinical papers, so we will not consider it at this time. Suffice it to say that some investigators found osteogenic power in periosteum, and others did not.

We approached the subject with, as far as possible, unbiased minds, although if we had a leaning more one way than another, it was that periosteum was a bone producing tissue. In order to clear the matter up for our own satisfaction we have repeated during the last two years many of Macewen's experiments, and also have carried out a number of our own².

* The full text of this paper was published in the Johns Hopkins Hospital Bulletin, March, 1915.

¹ "The Growth of Bone" William Macewen, F.R.S. (1912)

² In many of the original reports there is paucity of detail as to whether macroscopic particles of bone were adherent to and transplanted with the periosteum. We feel that definite conclusions as to the bone-producing power of periosteum can only be drawn from those experiments in which every effort was made to remove the periosteum without particles of the underlying bone. The character of the wound healing is also very lightly touched upon in many of these papers. It is also well to bear in mind that Ollier's classic work on bone and periosteum was done in the pre-antiseptic period of surgery.

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in the subcutaneous tissue 6 times, and in muscle tissue once. The specimens were examined 11, 64, 67, 127, and 128 days after operation. In each experiment there was definite bone formation. This bone growth was very much smaller than might have been expected from the size of the transplant with attached shavings. In no experiment was the new bone more than 4 mm long by 1 mm thick. In no instance was there more than a very slight roughening of the surface of the femur, from which the periosteum and bone shavings had been removed.

This group of experiments shows definitely that free periosteal flaps, with bone shavings attached, produce new bone. When compared with the results of transplantation of free periosteum without bone particles, it shows that bone particles and accompanying osteoblasts are necessary for the production of bone. It may be that this new bone would eventually have been absorbed, as the specimens contained a great deal less bone than was originally transplanted, in spite of the fact that so large a surface was exposed for the reception of a new blood supply.

E THE TRANSPLANTATION OF FREE PERIOSTEUM WITHOUT BONE PARTICLES, CONGEALED IN A BLOOD CLOT, INTO THE SUBCUTANEOUS TISSUES OF THE SAME ANIMAL—*Summary*—Eight experiments were done on dogs. The periosteum was obtained from the shaft of the femur. The flaps varied between 2 and 4 cm in length, by 75 cm to one-half the circumference of the femur in width. In each experiment the periosteum was bunched and congealed in a blood clot, which was placed in the subcutaneous tissue. The specimens were examined 20, 87, 100, 112, and 113 days after operation. In 4 experiments, after 20, 87, 100 and 113 days, a well marked scar was found, with no evidence of bone formation, either by X-ray or by careful dissection. In 4 others, 100 and 112 days, a tiny calcified mass, scarcely 1 mm in diameter, was found at the site of the transplant. In the 100-day specimen there had been a slight superficial infection of the skin wound, and although this was at some distance from the transplant, it may have had an influence on the deposit of lime salts. Microscopic examination showed definite new bone formation in both specimens, but it was much more marked in the one than in the other. In the 112-day experiments, on the other hand, the healing had been *per primam*, and the calcified material was smaller than in the 100-day experiments. Microscopic examination showed calcified material, but no definite bone tissue.

tion, and in no instance could any growth of bone be detected, either by X-ray or by careful dissection

B THE TRANSPLANTATION OF FREE PERIOSTEUM WITHOUT BONE PARTICLES INTO THE MUSCLE OR SUBCUTANEOUS TISSUE OF ANOTHER ANIMAL OF THE SAME SPECIES —*Summary*—Five experiments were done on dogs. The periosteum was obtained from the circumference of a resected portion of the radius, varying in length between 2.2 and 3 cm. The transplants were placed in the subcutaneous tissue in 3 experiments, and in the muscle in 2. In each experiment the periosteum was bunched. The specimens were examined 27, 91, 121, 123, and 126 days after operation, and in no instance was any growth of bone detected, either by X-ray or by careful dissection.

C THE INJECTION INTO THE SOFT PARTS OF SMALL BITS OF PERIOSTEUM WITHOUT BONE PARTICLES IN SUSPENSION —*Summary*—Six experiments were done on rabbits. The periosteum was obtained from the tibia in each instance. The flaps varied between 2 and 3 cm long, by 5 cm wide. The periosteum was cut into small bits with scissors, and was shaken up with from 10 to 15 minims of normal salt solution in 3 experiments, in Ringers' solution in 2 experiments, and in blood in 1 experiment. The injections were made into the subcutaneous tissue and muscle, 3 times each. The specimens were examined 10, 13, 29, and 32 days after injection. In 1 experiment, 32 days after injection of periosteum in salt solution, a single oblong bit of calcified tissue, 4 mm by 2.5 mm, was found. There is doubt as to the origin of the fragment, as the injection was made subcutaneously in the lateral aspect of the middle of the thigh, while the calcified tissue was found close to the joint beneath the *rectus* muscle. Microscopic examination showed deep staining calcified material with no bone. In the other experiments no bone formation could be demonstrated, either by X-ray or by careful dissection.

These three groups of experiments show that neither free auto- nor isoperiosteum has the power of bone production when transplanted into soft parts, even though a considerable number of osteoblasts be adherent to the transplant.

D THE TRANSPLANTATION OF FREE PERIOSTEUM WITH THIN BONE SHAVINGS ATTACHED, INTO SOFT PARTS OF THE SAME ANIMAL —*Summary*—Seven experiments were done on dogs. The periosteal flap with shavings of bone attached was obtained from the femur in each instance. It was either raised with a very thin chisel, or roughly with a curette. The flaps varied between 3 and 3.5 cm in length, by 1 cm to one-half the circumference of the femur in width. It was placed

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the flap, and on the ribs the adjacent soft parts. In 2 experiments the flap was accidentally detached from the rib, but its attachment was placed in contact with the denuded bone and secured. In each experiment the bone-periosteal flap lived and new bone formed from it. The intermediate cartilage stage was noted in the femur flaps, but not in the rib flaps.

These experiments show that pedunculated flaps of periosteum with a thin bone film will live and produce new bone, and become greatly thickened. This thickening was considerably reduced in the 171-day experiment, as might be expected. These experiments are of some clinical interest, as this is undoubtedly what happens when a strip of periosteum with bone, still attached to the bone at one end, is raised by trauma, and accidentally implanted in adjacent soft parts. The contrast between this group and the pedunculated flaps of periosteum in soft parts without bone particles attached, is very significant, and further strengthens the conclusion that the presence of bone on periosteum is necessary for the production of bone (Fig 1).

Remarks—From the results of Groups I and II, we find that free periosteum without bone particles adherent to it will not produce new bone when transplanted into muscle or subcutaneous tissue of the same animal. That this is also true for iso-transplants of periosteum alone. That new bone was found in 2 experiments, and calcification in 2, in which the free periosteum had been congealed in a blood clot before transplantation. In the 2 experiments in which bone was found, it is possible that small bits of bone were accidentally transplanted with the periosteum. That free periosteal flaps with thin bone shavings attached did produce bone in each experiment. That pedunculated flaps of periosteum without bone did not produce bone in a single instance. That pedunculated flaps of periosteum with a thin film of bone did produce bone in every instance.

The clinical use of the free transplantation of periosteum is of value only in those instances where periosteum has been employed to fill in defects. In such operations the result depends entirely on the formation of bone, and bone will not be formed unless bone is transplanted with the periosteum. The chances are that even the new formed bone will eventually be absorbed. The pedunculated periosteal flap with a thin film of bone attached is of considerable interest as it may help to explain some of the remarkable post-traumatic X-ray plates which are sometimes difficult to interpret.

periments showing calcification no bone could be found. It is well known that calcification in blood clots occasionally occurs, and it is possible that the presence of periosteum without bone particles in the blood clots may have influenced the deposit of lime salts. Taking into consideration the preceding experiments, it is probable that in the 2 experiments where bone was definitely demonstrated, some particles of bone had accidentally been transplanted with the periosteum.

GROUP II THE TRANSPLANTATION OF PEDUNCULATED FLAPS OF PERIOSTEUM

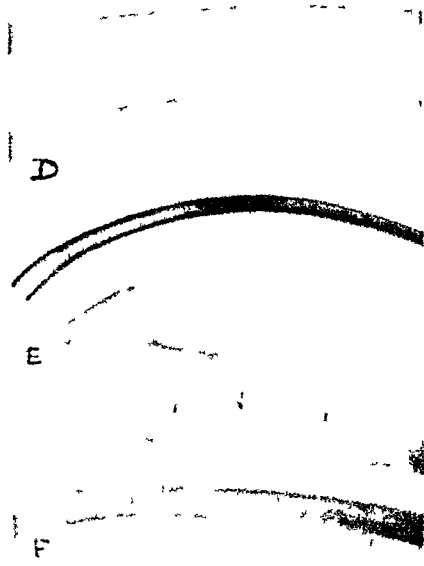
A THE TRANSPLANTATION OF PEDUNCULATED FLAPS OF PERIOSTEUM WITHOUT BONE PARTICLES INTO, OR AROUND, ADJACENT MUSCLE—*Summary*—Four experiments were done on dogs. The radius was utilized in each instance. The flaps were from 1 to 1.5 cm wide, and from 3 to 4.5 cm long. In 2 experiments the pedicle was left attached to the shaft of the bone, and in 2 to the epiphyseal line. In 1 of each the flap was drawn out into the adjacent muscle tissue, and in the others the free end was sutured to the cut edge of the radial periosteum. The specimens were examined 151, 212, 216, and 220 days after operation. In none of these experiments could any bone formation be demonstrated, either by X-ray or by careful dissection. In 2 experiments the surface from which the periosteum was raised was scarified, and in each of these there was slight roughening of the bone at the point of scarification. This also occurred in 1 experiment where the bone was not scarified, while in the other the bone was perfectly smooth. The roughening could be felt rather than seen. It was easy to demonstrate the area from which the flap was raised, as the line of incision was outlined at the time of operation with sterile India ink, and enough remained to definitely show the location.

These experiments show that there is no bone formation from periosteum, even though the periosteal flap is still attached by a pedicle to the bone itself.

B THE TRANSPLANTATION OF PEDUNCULATED FLAPS OF PERIOSTEUM, WITH A THIN FILM OF BONE ATTACHED, INTO ADJACENT SOFT PARTS—*Summary*—Eight experiments were done on dogs, four on the ribs and 4 on the femur. The specimens were examined 23, 34, 50 and 171 days after operation. The flaps on the femur varied from 2 to 3 cm long, by 8 to 1 cm wide, on the ribs from 1 to 3 cm long, by the width of the rib. On the femur the muscles were sutured beneath



FIG. 1—A pedunculated flap of periosteum with a thin film of bone was raised from the femur and also from a rib. The soft parts were sutured beneath them. Photographs and X-ray taken 50 days later. The bone was accidentally broken away from the femur before X-ray was taken.



off the periosteum, unless the nutrient artery was interfered with. In those instances in which the artery was cut, the bone was apparently normal, but the X-ray showed changes in its nutrition. In very few instances was the bone from which the periosteum was stripped visibly thickened, unless it had been considerably traumatized. In some instances, in spite of chiselling and scraping, there was practically no overgrowth of new bone.

The defects in the periosteum were, in many instances, replaced by a fibrous membrane, which resembled the periosteum in appearance, but was much more tightly adherent to the bone than was the normal periosteum. In some instances the muscle tissue was tightly adherent to the bone.

GROUP III THE SUBPERIOSTEAL RESECTION OF BONE, LEAVING THE PERIOSTEAL TUBE, AS FAR AS POSSIBLE, UNDISTURBED

Summary—Eleven experiments were done on dogs. In 8 experiments, sections of rib were removed, and in 3, sections of the radius. The length of the pieces of rib removed varied between 1.5 and 3 cm. The length of the sections of radius varied between the entire radius with articulating surfaces and 2.5 cm. of the shaft. Metal caps were placed on the bone stumps under the periosteum in 3 experiments. The specimens were examined 14, 28, 31, 87, 100, 105, 106, 129, 141, 143, and 146 days after operation. In 4 of the experiments the periosteal tube was closed separately. In 7 the periosteal tube was drawn together by closure of the overlying soft parts (Fig. 2).

Remarks—This group shows that the periosteum acts only as a limiting membrane. In those experiments without metal caps where the periosteal tube was closed separately, the size of the new-formed bone was almost normal. In those where the periosteal tube was not closed the bone was somewhat irregular in shape. In none of the experiments could it be definitely demonstrated that the new bone was produced from the periosteum. The only instance where new bone occurred along the periosteal tube was in the resection of a portion of the radius, in which experiment no particular attention was given to the removal of bone particles from the line of muscle attachment. Even in this experiment the growth of bone was much more marked at the radial stumps. In the metal cap experiments the growth of bone was definitely from the shaft of the bone behind the caps, rather than from the periosteum (Fig. 3).

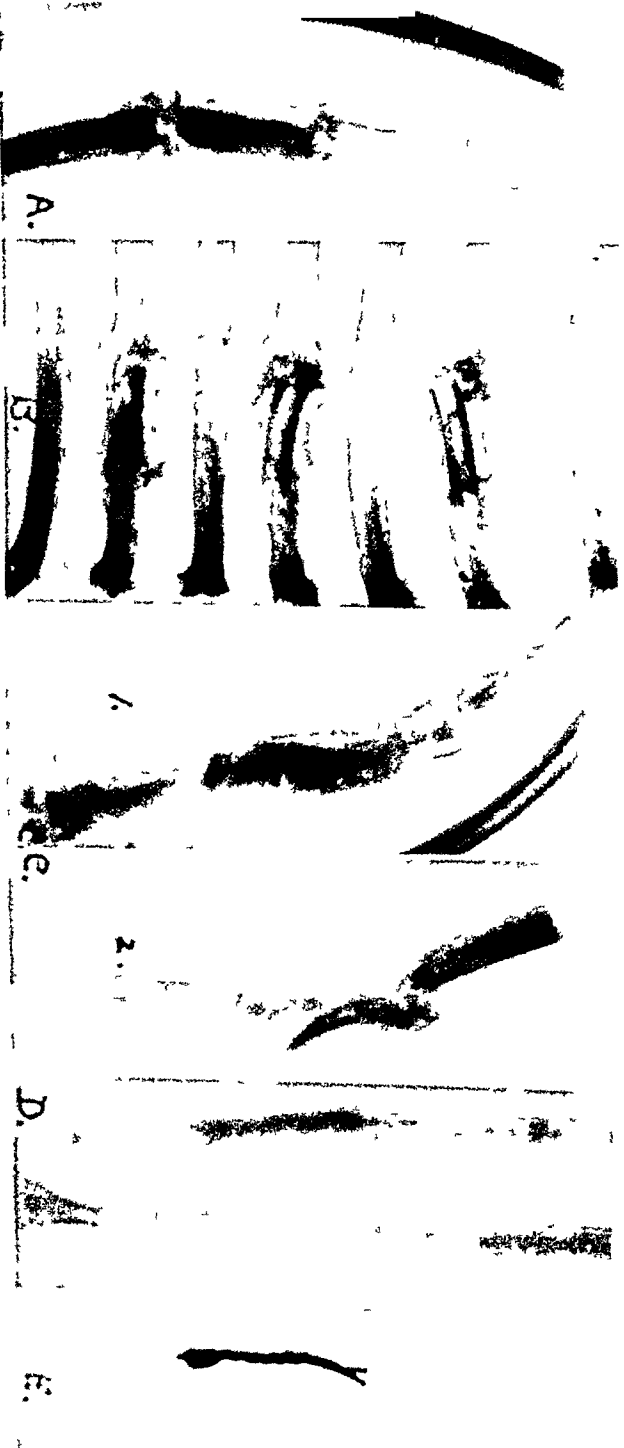


FIG. 1.—1. Auto skull bone, without peristomium in defect left by subperiosteal resection of upper 1/3 of rib. The rib was 15 days later taken 35 days later. 2. Sections of two ribs without peristomium in defects left by subperiosteal resection of upper 1/3 of rib. The peristomium was closed over each X-ray taken 14 days later. 3. Auto bone fragment with rib placed in defect of upper 1/3 of rib. The peristomium was not closed in either experiment. X-ray taken (a) after 50 days, (b) after 67 days. 4. Pericostum in the defect after subperiosteal resection of 2 cm of a rib. The pericostum was closed over the wire. X-ray taken 506 days later.

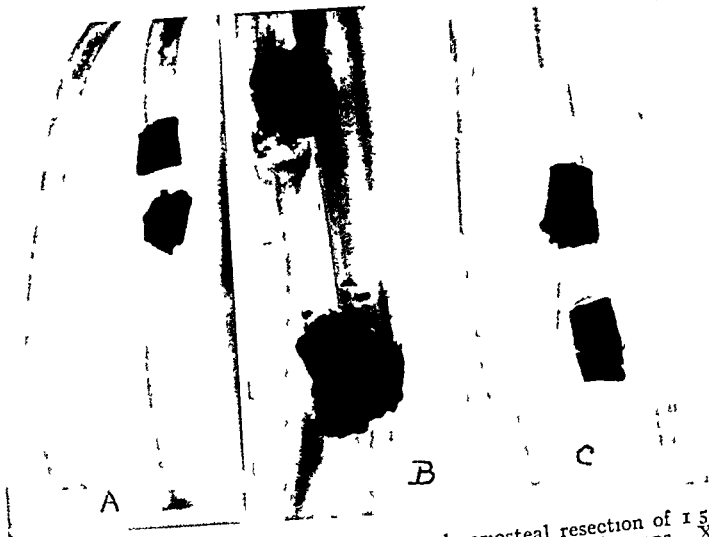


FIG 3—A Metal caps placed on stumps after subperiosteal resection of 1.5 cm of a rib. The tube between the caps was dry. The periosteum was closed over the caps. X-ray taken 28 days later. B Metal caps placed on stumps after subperiosteal resection of 2.5 cm of the shaft of the radius. The tube between the caps was dry. The periosteum was not closed. X-ray taken 106 days later. C Metal caps on the stumps after subperiosteal resection of 2 cm of a rib. A blood clot was placed in the tube between the caps and the periosteum was closed. X-ray taken 141 days later. In A there was no attempt at bone formation from the periosteum. In B the new bone was formed from the side of the shaft back of the lower cap. In C the same thing has occurred although the X-ray from above does not demonstrate it.



Fig 7—Split auto rib in skull defects A After 35 days The defect is entirely filled with rigid bone B After 49 days C After 89 days D After 105 days





FIG 5 —Silver wire experiments on dogs. A The upper wire was placed over intact periosteum, the middle wire was placed over a cuff of fascia lata after removal of the periosteum and the lower wire was placed on the bone after removal of a zone of periosteum. X-ray taken 44 days later. B Wire around denuded bone after 91 days. C The upper wire was placed over intact periosteum, the lower wire was placed around the bone subperiosteally. X-ray taken 167 days later.

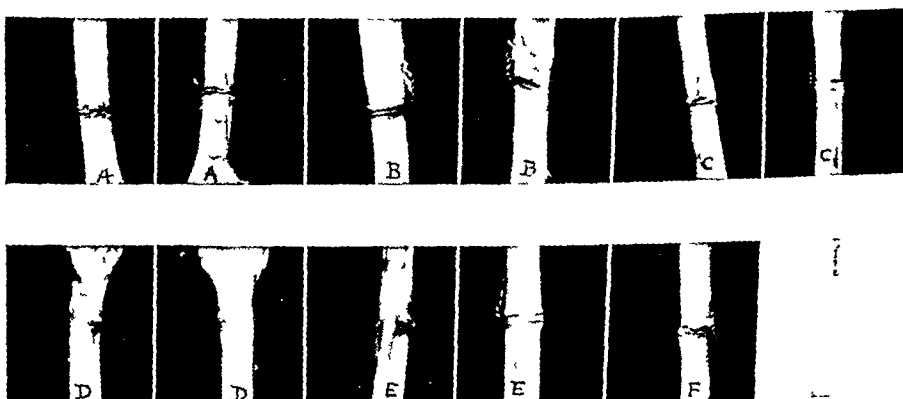


FIG 6 —Silver wire experiments on rabbits. Front and back views. Silver wire was snuggly wrapped around the shaft of the femur after removal of zones of periosteum from 1.5 to 4 cm wide. A After 44 days. B After 48 days. C After 54 days. D After 121 days. E After 122 days. F After 122 days. In A and D no precautions were taken against infection. In E the bone was curetted before the wire was applied.

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GROUP IV THE TRANSPLANTATION OF BONE AND OTHER SUBSTANCES INTO THE PERIOSTEAL TUBE AFTER PARTIAL SUBPERIOSTEAL RESECTION OF A RIB

Summary—Twenty-one experiments were done on dogs. The length of the sections of rib removed varied between 1.5 and 3 cm. The periosteum was closed over the transplant in 18 experiments, and the transplant was held in the periosteal trough by sutures in 3 experiments. Autobone with periosteum, and without periosteum, was used in 3 each. Isobone without periosteum was used in 10. Autocartilaginous rib with perichondrium, an intact phalangeal bone, cowhorn, dried isotendon, silver wire, and insoluble gelatin, were used in 1 each. The specimens were examined 24, 30, 31, 35, 44, 50, 92, 94, 100, 105, 107, 146, 206, and 215 days after operation (Fig. 4).

Remarks—In each experiment in which the transplant was covered with either periosteum or perichondrium, the growth of bone wherever present originated from the rib ends and not from the periosteum. The periosteum and cartilage of the intact phalangeal transplant prevented the entrance of any new bone from the rib ends, and the transplant was pushed to one side by the bone growth from the rib ends, as an impervious foreign body would have been. The periosteal covering of the other transplants allowed the growth of bone to enter the transplant only from the ends. In those instances where there was growth over the surface of the transplant, it ran between the periosteal tube of the rib and the periosteal covering of the transplant. In those experiments in which the transplant was without periosteum we found that both auto- and isobone caused very marked stimulation of bone growth, both from the rib ends and from the periosteum, in a comparatively short period of time. The stimulation of bone growth was much more marked than in the experiments where periosteum was left on the transplant. It was noted that transplants of the same size under exactly the same conditions acted quite differently; some apparently causing more stimulation than others. Some acted as a foreign body, some were undergoing absorption; some had disappeared while others were incorporated in the continuity of the bone. In no instance could new bone formation be demonstrated from the grafts.

The cowhorn and dried isotendon had been absorbed, and the continuity of the ribs restored. It was impossible to say whether the new bone formation was from the rib ends or from the periosteum. In the experiment with the gelatin roll, the continuity of the ribs was not

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around a bone subperiosteally. Thus it would seem that in those experiments reported by others in which the ring was completely buried in new bone either there was infection or the surface of the bone was much traumatized after or during the removal of the periosteum.

Clinically, I have noted when bones had been sutured with silver wire that there was usually absorption beneath the wire, rather than new bone formation over it.

GROUP VI THE IMPLANTATION OF BONE AND ALSO PERIOSTEUM INTO PREPARED DEFECTS IN THE SKULL

Summary—Nine experiments were done on dogs. In 2 experiments autoperiosteum was transplanted, in 4, auto split rib without periosteum, in 1, auto rib cut into bits, in 2, iso split rib was used. In 1 experiment the defect was made with a trephine, and in 8 with the Hudson burr. The diameter of the defects varied between 1.1 to 2 cm. The transplants were placed on the dura in each instance. The specimens were examined 35, 49, 93, 105, and 146 days after operation.

Remarks—These experiments show that transplants without periosteum retained their vitality, and that there was proliferation of bone from them, as well as from the edges of the defects. This was especially noticeable in the small fragments, as there was comparatively a much larger raw surface and consequently better blood supply. The new bone seemed to come from the cut surfaces, rather than from the surface from which the periosteum was stripped. In 1 experiment there was new bone found in a periosteal strip which had been scraped from a rib (thus making bone particles possible), but, in another experiment, where there was positively no bone attached to the periosteum, no new bone was formed. In 2 experiments where isografts without periosteum were transplanted the outlines of the grafts were still present after 105 and 146 days. The transplants had been replaced by new bone from the edges following the line of the grafts. The stimulation of the edges of the defect seemed as great where isobone was transplanted as when autotransplants were used, also the closure of the defect was equally as good in each (Fig. 7).

GROUP VII. AUTOGENIC IN SOFT PARTS

Summary—Twenty-five experiments were done on dogs. In 8 the bone was transplanted with its periosteum; in 17 without periosteum. In 11, a piece of the rib was used; in 4, portions of the radius, in 7, portions of the plate, in 2, bone shaving from the skull, and in 1,

restored, even after 215 days. The gelatin was still present, and there was growth of bone from both rib stumps, extending a short distance into it. There had been no periosteal bone formation.

In the experiment with twisted silver wire the rib had regenerated, and the wire was pushed to one side by the bone formation which had gone on beneath it from the rib ends. Had the growth of bone been from the periosteum the wire might have been surrounded by bone. Transplants covered with periosteum, and also foreign bodies, seem to have no effect on the periosteum, but in each experiment there was stimulation of growth from the rib ends.

GROUP V SILVER WIRE EXPERIMENTS

Summary—Fourteen experiments were done on 8 dogs, and on 6 rabbits. The femur was used in 6 experiments, the humerus in 5, and the radius in 3. In 7 experiments the silver wire was wrapped snugly around the bone after removal of the periosteum. The bone was curetted in 1 experiment, no precautions were taken against infection in 2, and in 1 of these the bone was also scraped. In 2 experiments the wire was placed over intact periosteum, in 1 over a fascia cuff, after removal of the periosteum, and in 1 subperiosteally. The zone of periosteum removed varied in width between 1 and 3 cm.

Remarks—There was no visible thickening of the area from which the periosteum was stripped in the dog experiments, but there was definite thickening over this area in each instance in the experiment on rabbits (Fig. 5). In fact there seemed to be a somewhat greater tendency to bone growth in the rabbits in this group of experiments than in the dogs (Fig. 6).

One is struck by the fact that the most extensive growth of new bone around the wire occurred in the experiments where no precaution was taken against infection, and also where the bone was curetted after removing the periosteum. The thickest growth was always posteriorly, in the region from which the muscle attachment was torn, or, in other words, where the bone was most traumatized.

From these experiments we are led to believe that there is little if any new bone formed from the surface of a bone after removal of the periosteum, unless the bone surface itself is irritated, either mechanically or by infection. That absorption occurs when silver wire is snugly applied around bone over intact periosteum, and also at times when around denuded bone. That there is little if any new bone formation from the periosteum or bone when a silver wire is placed

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point it would seem likely that the bone shavings with blood would have survived better than the solid pieces

From the above experiments we feel justified in saying, that in the large majority of cases absorption takes place when a transplant of auto-bone, either with or without its periosteum, is placed in soft parts. We cannot say what would be the fate of those transplants which have grown together and produced new bone, but as absorption was also going on in the bone, and as the tendency of free bone in soft parts is to be absorbed, it seems logical that absorption would eventually have taken place (Fig 8).

GROUP VIII ISOBONE IN SOFT PARTS

Summary—Nine experiments were done. In 3 the bone was transplanted with its periosteum, and in 6 without the periosteum. In 4 the radius was used, the rib and the skull in 2 each, and the fibula in 1. The longest bone fragment was 2.4 cm., and in 1 instance bone shavings were transplanted. The specimens were examined 11, 13, 33, 74, 93, 100, 145, 147, and 151 days after operation. The transplants were placed in the subcutaneous tissue in 5 instances, in the muscle in 3, and in the abdominal cavity in 1 instance.

Remarks—It is again difficult to draw definite conclusions in this group, except that absorption takes place, which would probably eventually lead to complete disappearance of even those transplants in fairly good condition.

A cross-section of the radius, with periosteum, showed beginning absorption from the ends when examined 33 days later; another section of the radius, with periosteum, was in a good state of preservation 151 days after transplantation, except that considerable absorption had taken place from the ends. The periosteum seemed to have some power of preventing absorption when it remained attached to the bone. On the other hand a piece of split radius, without periosteum, was still present after 145 days, although absorption was progressing. In no instance was there any attempt at new bone formation from the transplants.

an intact phalangeal bone. The bone fragments varied in length between 5 and 3 cm. The specimens were examined 11, 14, 19, 20, 55, 67, 94, 100, 104, 108, 113, 127, 128, 141, 143, 147, 206, and 207 days after operation.

Remarks—It is a difficult matter to draw conclusions from this group of experiments, as in some instances the findings seem to contradict each other. Those experiments where the bone was transplanted without periosteum present very different pictures. Beginning absorption was noted as early as 19 days. A section of rib 2 cm long had disappeared in 104 days. Then, on the other hand, portions of almost transparent bone were still present after 113, 128, 141, 143 and 207 days, while transplants of the same size in the same animals were absorbed in the same length of time. The rib transplants became flexible. In 3 experiments the transplants were placed close together. In 2 of these where sections of the whole rib (in the subcutaneous tissue, and split rib in muscle) were used, there was definite new growth of bone and growing together of the fragments, but at the same time there were marked absorptive processes going on, and the resulting mass was paper thin and almost transparent. When 2 pieces of the fibula were placed side by side in muscle, no such growth was noted.

Those experiments where the bone was transplanted with its periosteum seem to show that the periosteum has a certain protective action on the transplant. Sections of fibula without periosteum had markedly softened and reduced in size, after 128 days, while a control section of fibula covered with periosteum was practically intact in the same length of time. A section of rib with a strip of periosteum had been absorbed in 108 days, while an intact phalangeal bone was still present after the same length of time, although reduced in size.

In practically all of the transplants which remained at time of examination there were signs of absorption, which were more or less marked. In only 2 of the entire group was there any attempt at new bone formation, and even in these marked absorption was also going on. The periosteal covered transplants seemed to be somewhat more resistant to absorption than those without periosteum. There was little difference in result, whether the transplants were placed in muscle or in subcutaneous tissue.

The blood supply probably has a good deal to do with the length of time a transplant can remain in soft parts without absorption. The type of bone used may also have some bearing on this point, a porous bone being easier to nourish than solid bone. If this was an important

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Absorption occurred when a silver ring was snugly applied around a bone over the periosteum, and also at times when it was applied around denuded bone. There was no new bone formed from either the periosteum or bone when a silver ring was placed around a bone beneath the periosteum.

Both auto- and isobone, without periosteum, were effective in repairing skull defects.

Auto- and isobone, without periosteum, when transplanted into the periosteal tube after subperiosteal resection of a rib, caused stimulation of bone growth from the periosteum, and also from the rib ends.

Transplants covered with periosteum, and foreign bodies, stimulated bone growth only from the rib ends.

Transplants of the same size in a periosteal tube, after subperiosteal resection, under exactly the same conditions, acted quite differently.

After subperiosteal resection of a portion of a bone, the growth of bone in repairing the defect was from the bone stumps, the periosteum acting as a limiting membrane.

Autobone, both with and without periosteum, lived and was successfully transplanted to fill defects in bone. Clinically, it is advisable to transplant bone covered in part, at least, with periosteum.

Isobone in a bone defect acted as a scaffold for the growth of new bone from the living bone stumps, but there was ultimate absorption of the transplant.

Autobone, both with and without periosteum, was absorbed when transplanted into soft parts.

The periosteum seemed to have some protective influence against early absorption.

The fate of those transplants which had grown together and produced new bone is doubtful, but as absorption was going on, and as the tendency of free bone in the soft parts is to be absorbed, it seems probable that absorption would eventually occur.

The same may be said of isobone in soft parts, except that in no instance was any new bone formed from the transplant.

The growth of new bone from bone stumps after resection of a portion of a bone with its periosteum is astonishingly slow, being very little more advanced after 6 months than after 6 weeks.

in 2 each, and from the femur in 1. They were without periosteum 5, and with periosteum in 3. The specimens were examined 16, 64, 89, 113, 130, 144, and 152 days after operation.

Remarks—These experiments show that autobone, both with and without periosteum, may be successfully transplanted to fill defects of bone. Tiny bits may be used, or one single piece. The transplant tends to assume the size of the bone into which it is transplanted.

GROUP X ISOBONE IN BONE DEFECTS

Summary—Seven experiments were done on dogs. The defects were prepared in the radius in 6, and in the fibula in 1. The periosteum was removed with the bone in each experiment. The resected bone varied between 1.8 and 3 cm. The transplants were obtained from the radius in 5, and from the tibia and fibula in 1 each. In 2 experiments the transplants were covered with periosteum. The specimens were examined 20, 27, 29, 74, 121, 123, and 126 days after operation.

Remarks—This group leads us to believe that isobone in a bone defect stimulates the growth of bone from the bone stumps. The transplant acts as a sort of scaffold to the growth of new bone, from the living bone stumps. That there is shortening of the bone into which the transplant is placed, and that there is ultimate absorption of the transplant.

CONCLUSIONS

Free periosteal transplants did not produce bone in the large majority of experiments, even though osteoblasts were adherent to the transplants.

Pedunculated flaps of periosteum did not produce new bone.

Free periosteal transplants and pedunculated periosteal flaps with bone shavings attached produced bone in each experiment. From these we might surmise that bone particles had been accidentally transplanted in those experiments in which bone was found after the transplantation of free periosteum.

The removal of periosteum had little, if any, effect on the nutrition of a bone. The surface from which the periosteum was removed showed very little overgrowth of bone, unless there had been considerable irritation of that surface, either by trauma or by infection. The area from which the periosteum was taken was covered by a thin, non-adherent fibrous membrane, or the muscle tissue was adherent to the denuded area.

GUNSHOT INJURIES OF THE SPINAL CORD

muscles freed from the spinous processes and laminæ of the included vertebræ on the left side of the spine, and retracted laterally. The point of the bullet was readily discovered between the laminæ of the twelfth dorsal and first lumbar vertebræ, and the extraction of the bullet by means of a dressing forceps was a simple matter. The space occupied by the bullet led down to the right side of the dura, where compression of the cord must necessarily have existed. The dura appeared to be intact, so no further exploration was attempted. Several small fragments of loose bone from the lamina of the twelfth dorsal vertebra were extracted. The muscles were allowed to fall back into place and sutured to the periosteum of the spinous processes with interrupted chromic gut, a gauze drain being inserted down to bone in the middle of the wound. The fascia was closed in a similar manner, the skin with interrupted silkworm-gut.

October 17. Skin over lower sacrum, 5 cm. in diameter, broken down. Gauze drain removed from wound.

Subsequent Course—The wound healed by primary union. During the first week after operation, there was a slight return of sensation in both thighs down to the knees. There was also a slight return of muscular power in the flexors of the hip-joint, more especially on the right side, so that the patient could raise his right knee from the bed. From that time on the improvement was very gradual. The last examination made by Dr. Craig on November 15, a month after operation, showed a complete flaccid paralysis of both legs, neither flexion nor extension of the feet being possible. The calves are atrophic. The thighs are weak, but when the legs are passively extended or flexed they can be moved weakly in the opposite direction. The power of the adductors is very good. Reflexes in knees and ankles absent. No plantar response. Sense of position lost in right ankle and toes of both feet, but preserved in left ankle. There is a slight return of sensation in both bladder and rectum, but no return of control. The over the knee scar has not extended, but remains unhealed.

Case II.—A. aged thirty-one. On October 6 at 3 p. m., near Jena, the patient was lying face downward in a field, clad in his uniform and great coat. He suddenly felt a sharp stinging sensation in the back, but heard no sound. He immediately lost all sensation in his lower extremities, and was unable to move them. He lay there nearly 90 min. when he was moved to the rear. He was not revived that night.

GUNSHOT INJURIES OF THE SPINAL CORD

A PRELIMINARY REPORT UPON FIVE CASES

By RICHARD DERBY, M D

OF THE AMERICAN AMBULANCE IN PARIS

THE following cases of gunshot injuries of the spinal cord were observed at the Hospital of the American Ambulance in Paris during the autumn of 1914

CASE I—J G, aged twenty-three On September 22 at 6 A M, the patient was standing in an open field, clad in uniform and great coat. He heard a rifle report and at once felt a sharp, cold sensation in his legs He fell upon his face and was not able to move his legs or arms After ten hours he was removed from the field He became incontinent of urine and fæces He was catheterized for the first time, four days after his injury

On September 27 he was admitted to the American Ambulance in Paris

On October 2 slight power of sensation was noted over the left leg Complete motor paralysis of both lower extremities

On October 14 slight sensation was elicited over the outer aspect of the left thigh to the knee, otherwise there was complete sensory paralysis of both lower extremities up to the level of the anterior superior spines of the ilia Very slight power of contraction of left psoas muscle, otherwise complete motor paralysis of both lower extremities Flaccid paralysis of bladder Paralysis of anal sphincter and rectum Reddening of skin over low sacrum, otherwise no trophic disturbances

There is a small circular healed wound of entrance in the left flank, 5 cm from the vertebral column, and on the level of the twelfth dorsal vertebra

The X-ray (Figs 1 and 2) shows a rifle bullet at the lower level of the twelfth dorsal vertebra, lying directly in the spinal canal with its base against the anterior wall of the canal, its point directed backward and slightly downward and to the left Apparently the bullet was deflected, by the body of the twelfth dorsal vertebra, more than a right angle from its original course

Operation (October 16) —Under ether anæsthesia, an incision 10 cm in length was made between the tenth dorsal and fourth lumbar vertebræ, just to the left of the midline of the back, carried in depth to the deep lumbar fascia This fascia was then divided in the same line, and the erector and multifidus sp



Fig. 1—Case I (see Fig. 1). Rifle bullet in spinal canal.

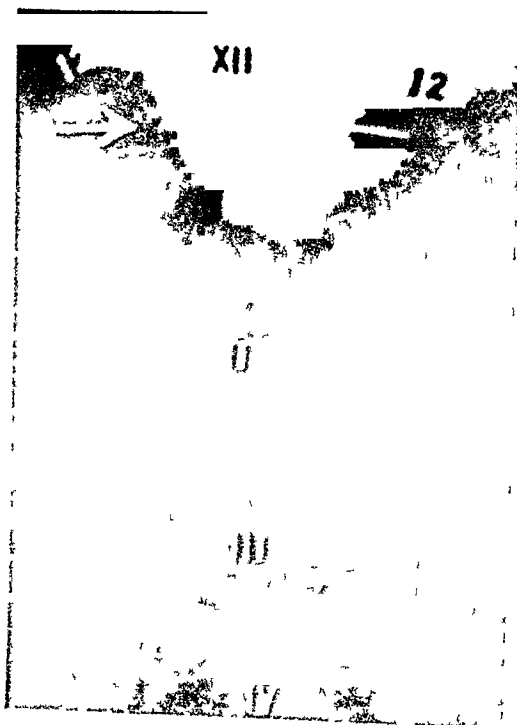
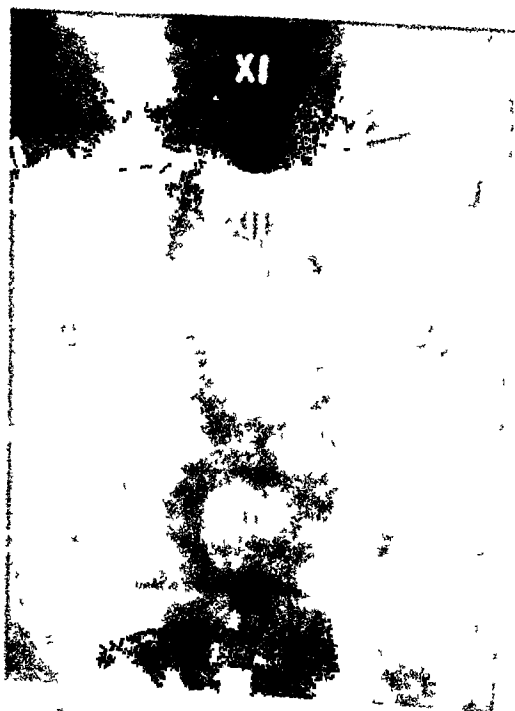
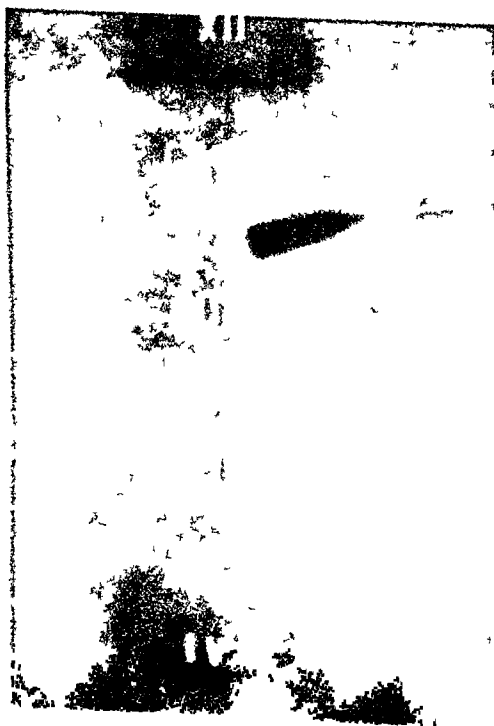


Fig. 2—Case I (see Fig. 1). Anteroposterior view. Rifle bullet in spinal canal.



mosis of the skin of the back. No point of tenderness or deformity made out along the spine. There was a small circular wound of entry posterior to the angle of the left scapula. Complete motor and sensory paralysis below the waist, with an absence of reflexes. Fecal incontinence and a greatly distended bladder, containing thirty-two ounces of urine.

On October 17 examination elicited very slight sensation along the outer aspect of the right thigh to the knee, and along the lower half of the inner aspect of the same thigh.

The X-ray (Fig. 3) showed a bullet with its base imbedded in the intervertebral disc between the first and second lumbar vertebrae, and its point directed upward and backward and to the right. The bullet had evidently crossed the canal from left to right, and had been deflected more than a right angle in two planes of its course. An exploration of its course was deemed advisable.

Operation (October 18).—Under chloroform and ether anesthesia, an incision 15 cm. in length was made between the tenth dorsal and fifth lumbar vertebrae, just to the left of the midline of the back, and carried in depth through the deep lumbar fascia. The muscles on the left side of the spine were stripped from their attachments to the spinous and transverse processes along the whole length of the incision, and retracted laterally. The left transverse process of the twelfth dorsal vertebra was found to be fractured, as well as the body of the first lumbar vertebra. Following the bullet sinus from this point downward and to the right, the dura was found to be in shreds, and the cord divided except for a few nerve filaments. Several small bone fragments were removed from the spinal canal. The bullet had apparently passed from this point in a downward direction, and from left to right, through the posterior portions of the bodies of the first and second lumbar vertebrae. No effort was made to find the bullet. The muscle and fascia were closed with interrupted plain gut sutures, a gauze drain being introduced down to the bullet sinus. The skin was closed with interrupted silkworm-gut.

Subsequent Course.—Four hours after operation the patient's condition became very bad, and during the night he developed oedema of the lungs. Under forced stimulation his condition improved, and in twenty-four hours' time it became satisfactory. The wound became infected with the bacillus pyocyaneus, which yielded to treatment. He developed a large sacral bed-sore, one over each trochanter. He also developed a cystitis, which improved under treatment.

An examination on November 8, three weeks after operation, showed a complete flaccid paralysis of both lower extremities with an atrophy of all the muscle groups of the legs, thighs

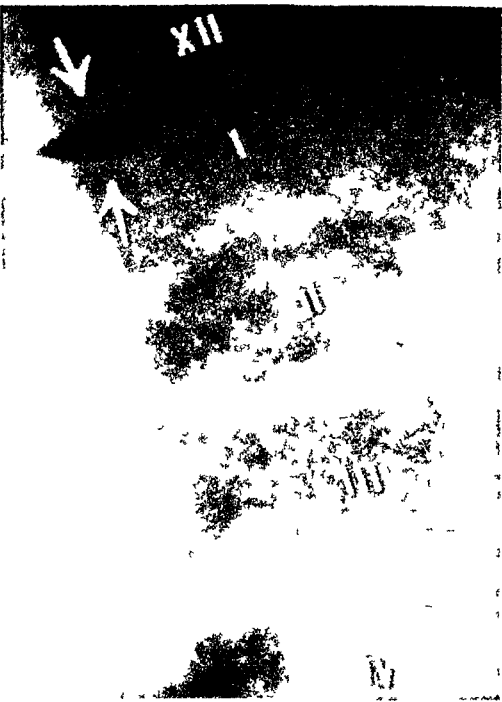
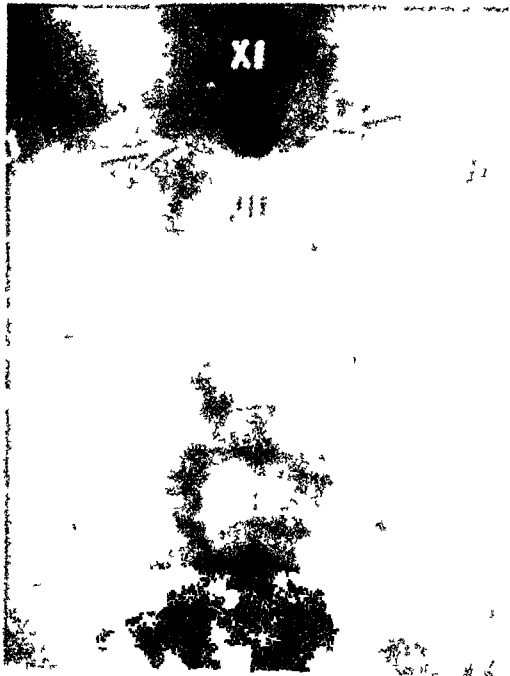
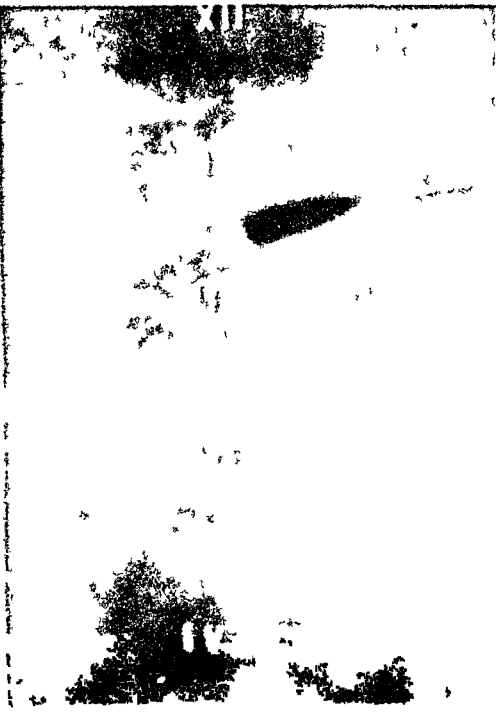


FIG. 1—(1) Lateral view. Right bulb perforating space canal between the plane of the cathode and the bulbular object.



FIG. 2—(1) Lateral view. Right bulb perforating space canal between the plane of the cathode and the bulbular object.



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Subsequent Course —Four hours after operation the patient's condition became very bad, and during the night he developed œdema of the lungs Under forced stimulation his condition improved, and in twenty-four hours' time it became satisfactory The wound became infected with the bacillus pyocyaneus, which yielded to treatment He developed a large sacral bed-sore, and one over each trochanter He also developed a cystitis, which improved under treatment

An examination on November 8, three weeks after operation, showed a complete flaccid paralysis of both lower extremities, with an atrophy of all the muscle groups of the legs, thighs and

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Subsequent to the operation, the patient told us that at the time he was wounded, his bayonet, which was hanging from the left side of his belt, was smashed to pieces. It was, in all probability, a rivet from his bayonet which was driven into his spinal column.

CASE V—J B V, aged twenty-six. On November 26 at 3 P M, the patient was standing, when he felt a dull heavy blow, and was thrown down. He experienced at once a loss of sensation in both lower extremities, and was unable to move them. He was moved to the rear at 7 30 P M.

On admission to the American Ambulance Hospital, on November 28, examination showed a circular wound just above the supero-internal angle of the left scapula. Complete sensory and motor paralysis of both lower extremities, with absence of reflexes. The loss of sensation extends upward to the level of the fifth dorsal vertebra. There is a flaccid paralysis of the bladder and fecal incontinence.

The X-ray (Fig 8) shows a shrapnel ball lying completely within the spinal canal, slightly to the right of the median line, and at the level of the intervertebral disc between the second and third dorsal vertebrae. (The radiographic print showing the lateral view was too dark for reproduction.)

Operation (November 29)—Laminectomy. An incision 10 cm in length was made down the midline of the back, with the second dorsal vertebra as a centre. The aponeurosis was opened to either side of the spinous processes, and the muscles stripped laterally from the spines and laminae. The spinous processes of the second and third dorsal vertebrae were removed. The ball was seen between the laminae of the second and third dorsal vertebrae on the right side. It was easily removed from the spinal canal, through the aperture which it had caused by fracture of the lamina of the right side of the second dorsal vertebra. The laminae of the third dorsal vertebra were removed, and a blood clot found and removed from around the dura. The dura was opened to the extent of 2.5 cm, exposing an oedematous arachnoid membrane. The cord itself did not appear to be damaged. The dura was left open, and the muscles and aponeurosis closed with interrupted plain gut sutures and the skin with interrupted silk-worm-gut.

Subsequent Course.—On the sixth day some of the skin sutures in the middle of the wound were removed, and the wound spread open at this point. Several other sutures were taken to bring the edges together again. The patient's temperature remained between 100° and 102°, with no explanation. On December 9 an abscess was discovered in the left buttock, which was opened. The patient became very much worse and died the next day.

Subsequent Course—The wound healed by primary union. No improvement since operation, except that the bed-sore presents a clean granulating base.

CASE IV—P. N., aged twenty-eight. On October 29 the patient was standing, when he heard an explosion nearby. He threw himself to the ground, and as he was falling, was struck. He experienced a dull, heavy sensation in the back, and lay on his face, unable to move his lower extremities. He was taken to the rear at once, and was not catheterized before his admission to the American Ambulance in Paris, forty-eight hours later.

October 31. There is a small irregular-shaped wound of entry in the left flank, on the level of the tenth dorsal vertebra, and 5 cm from the midline. The patient presents a complete flaccid paralysis of both lower extremities, bladder and rectum. The sense of position is entirely absent, as are the knee and ankle reflexes. There is a slight dorsal extension of both great toes, on stroking the soles. There is a faint response also to Oppenheim's method.

The X-ray (Figs 6 and 7) shows an oblong piece of metal at the level of the intervertebral disc between the tenth and eleventh dorsal vertebrae, directed downward, backward, and to the left, and encroaching upon the anterior portion of the spinal canal.

Operation (November 14).—Laminectomy. An incision 10 cm in length was made between the ninth dorsal and third lumbar vertebrae, and carried through the deep lumbar fascia. Parallel longitudinal incisions were made through the muscles on either side of the spinous processes, and the muscles separated from the laminae and retracted laterally. The spinous processes of the twelfth dorsal and first lumbar vertebrae were divided, and the muscle-bone flap reflected downward. In the same way the spinous processes of the tenth and eleventh dorsal vertebrae were divided and a similar muscle-bone flap reflected upward. The laminae of the first lumbar and eleventh and twelfth dorsal vertebrae were removed, and the dura opened longitudinally. The cord was found to be partially severed opposite the eleventh dorsal vertebra, and from the mutilated portion of the cord several fragments of bone were extracted. A metal rivet, which was firmly imbedded in the intervertebral disc between the tenth and eleventh dorsal vertebrae, was removed. The dura was closed with continuous plain gut suture. The muscle-bone flaps were brought together with plain gut sutures, and sutured laterally to the muscle edges. A gauze drain was introduced down through the muscle. The lumbar fascia was closed with interrupted plain gut, and the skin with interrupted silkworm-gut.

Subsequent Course—The wound healed by primary union. No improvement since operation.

GUNSHOT INJURIES OF THE SPINAL CORD

numerous gas bubbles The posterior cerebral fossa contains an increased amount of serosanguineous fluid

Spinal cord Removed

A circular wound is present just above the supero-internal angle of the left scapula, which passes obliquely downward, inward, and slightly forward to the level of the second dorsal vertebra The dura mater overlying this area is injected and surrounded by tissue filled with blood clots

An area of discoloration, with a solution in the continuity of the skin, is to be seen over the left buttock The buttock is markedly swollen, and on section reveals a track lined with necrotic, discolored tissue, which leads down to about the level of the ischial tuberosity of the left side, where an abscess cavity of the size of a small orange is found This cavity contains a thick, chocolate-colored, grumous pus, and is lined by an area of bluish-black discolored muscle The discoloration extends for the distance of 10 cm in depth The muscle of this area is dry, cloudy and somewhat discolored, giving the appearance of boiled beef

The tissues over both heels are dry and bluish-black in color

The cause of death was an infection from the bacillus *aërogenes capsulatus*, having its origin in the abscess in the buttock

In reporting these cases, I am much indebted to Dr Craig for his careful neurological examination of the patients and his advice at operation, to Dr Jaugeas for his excellent radiographs, and to Dr Jablons for his complete autopsy report

December 11 Autopsy

Heart Flabby The pericardial cavity is filled with a small amount of cloudy, yellow fluid The parietal pericardium shows numerous small ecchymoses, irregularly distributed The tricuspid valve admits two finger tips

The right auricle and ventricle contain clotted blood The blood content is entirely out of proportion to the size of the heart On aspirating blood for culture, numerous air bubbles come up with the fluid aspirated The mitral valve admits two finger tips easily The left ventricle contains clotted blood in small amount Post-mortem thrombus in pulmonary vessels and aorta Pulmonic valves intact

Left lung Dilated The pleural cavity is normal Ecchymoses are irregularly distributed throughout the entire left lung, most marked in the anterior lobe and over the posterior margin of the diaphragmatic surface On section the pulmonary vessels are found filled with blood clots On sectioning the lung there are areas which stand out very prominently These are infiltrated with blood and deep bluish-black in color They are present in the upper and lower lobes, with marked congestion and œdema of the lower lobe Pulmonary thrombosis is present, leading down to consolidated areas The bronchial glands are swollen and soft

Right lung is voluminously distended There are numerous areas of hemorrhagic consolidation These areas are more marked in the lower lobe

Tongue Negative

Tonsils Slightly enlarged but otherwise normal

Larynx and trachea Catarrhal inflammation of the mucosa

Thyroid gland Enlarged, no struma

Cervical glands Enlarged

Œsophagus Normal

Spleen Greatly enlarged, soft, somewhat flabby Weight, 380 gm The notches stand out very prominently Soft and very friable on section

Suprarenals Negative

Right kidney Large The capsule strips very readily The cortex is slightly congested and increased in size The markings are somewhat pale and cloudy The pelvis is thickened and injected

Left kidney Swollen and injected The cortex is markedly congested Small yellowish, circular areas, surrounded by reddish areolas, and coalescing in spots, are seen on section

Ureters The mucous membrane is injected, and there are marked inflammatory changes in the lower third

Liver Parenchymatous degeneration Hemorrhagic infiltration of the periportal tissues

Mesenteric glands Enlarged

Small intestine There is slight congestion of the duodenum, and ulcerations of the jejunum and ileum The follicles of the ileum stand out very prominently The blood-vessels are markedly injected throughout the intestinal tract Numerous areas of hemorrhage are present

Large intestine The walls are thickened

Bran On removal of the calvarium, the vessels of the scalp bleed profusely The dural vessels are injected The vessels of the pia contain

PERFORATING GUNSHOT WOUNDS OF THE ABDOMEN

wall should be enlarged, or the linea alba opened freely enough to allow a thorough inspection of the injured parts. Hemorrhage should be arrested. If intestinal wounds exist, they should be closed, trimming their edges first if they are lacerated or ragged, blood and other extraneous matter should be removed carefully, and then, in my opinion, provision should be made for drainage. If the original wound of entrance is dependent, drainage may be secured by keeping this open. If the wound is a dependent one and the aperture of exit dependent, the patency of this should be maintained, and, if necessary, a drainage of glass or other material inserted. When there is no wound of exit and the aperture of entrance is not dependent, then a dependent counter-opening should be made and this kept open with a drainage tube. If it is urged that the means suggested are desperate, it can be said in reply that the peril is so extreme in cases as now treated that nearly all die, and I believe by the means I have pointed out in gunshot wounds of the abdomen the patient will exchange an almost certain prospect of death for at least a good chance of recovery." So we see that the principles of surgery as laid down by Dr McGuire in 1873 furnish to-day the real ground-work for modern practice. Certainly Dr McGuire was a bold, free and original thinker, and I might add in passing that he really did pioneer work in establishing the rational treatment of abscess appendix cases.

The next great impetus given to the management of gunshot wounds of the abdomen came from that truly creative genius and pioneer surgeon of the South, J. Marion Sims. We are in the habit of thinking of Dr Sims's work as having to deal only with diseases of women. His work, of course, in this direction was extremely great. He was, however, a most accomplished surgeon. In 1881 in an article which appeared in the *British Medical Journal*, Dr Sims, in discussing the question of gunshot wounds of the abdomen, expressed the following opinion: "Given a case of penetrating abdominal wounds, one should open the abdomen promptly, clean out the peritoneal cavity, search for the wounded intestine, pare its edges and bring them together with suture and then treat the case as we now treat other cases of injury involving the peritoncum. Rest assured that the day will soon come when, with an accurate diagnosis in such cases, followed by prompt action life will be saved that otherwise must quickly ebb away." Shortly after Dr Sims's paper, there occurred an article by R. A. Kinloch of Charleston, S. C., on gunshot wounds of the abdomen treated by opening cavity and suturing intestine. This paper was published in the *North Carolina Medical Journal* of July, 1882. This paper not only reported a success-

PERFORATING GUNSHOT WOUNDS OF THE ABDOMEN

REMARKS ON A CONSECUTIVE SERIES OF TWENTY-SEVEN CASES WITH THREE DEATHS

BY LEGRAND GUERRY, M D , F A C S
OF COLUMBIA, S C

THE management of penetrating gunshot wounds of the abdomen is the great branch of emergency surgery in which Southern surgeons have played a very conspicuous part. The late Dr Hunter McGuire, a paper read before the Virginia Medical Society in November, 1873 not only advised, but urged, the treatment of these cases by exploratory celiotomy.

As far back as 1606 Fallopius advocated enlarging the external opening to expose intestinal injuries and to practise enterorrhaphy. Between 1606 and 1849 the same opinion occurs a number of times in the literature. In 1849, however, Pirogoff definitely expressed himself in favor of a similar practice as being the only way to prevent death. He enlarged somewhat on the opinion of Fallopius and really advised more of a systematic operation. In 1863 Legouest wrote as follows: "Lesions of the intestines by cutting weapons attended by extravasation of solid or liquid contents, and in shot wounds, it is then proper to enlarge the external wound with the bistoury, to draw the intestine outward and close the solution of continuity by suture." In 1865 the opposite opinion was expressed by Hamilton in his treatise on military surgery in which he says, "be assured that the patient will have a better chance for life if we let him entirely alone, and it surprises us that a good surgeon should think otherwise." Even Erichsen, as late as 1873, subscribed to a very compromising attitude about the management of intestinal perforations. He was not at all convinced in his own mind that surgery furnished even the best, say nothing of the only way, of dealing with the difficulty. I have mentioned only a few of the surgeons whose work led up to the modern treatment of such conditions. An excellent article by McRae, of Atlanta, Ga., will give a splendid résumé of the history of this subject to those who are sufficiently interested to read it. As has already been indicated, the first real logical, clear-cut and satisfactory statement of surgical principles and practice involved in the management of perforating gunshot wounds of the abdomen was given by the Dr Hunter McGuire before the Virginia Medical Society, in November, 1873. Dr McGuire wrote as follows: "The wound in the abdomen

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wounds of the abdomen, with one death. Up to the present time 19 other cases have been added to this list with 2 more deaths and it is to this series of 27 cases with 3 deaths that I now particularly wish to direct your attention. A brief summary of these cases may be interesting.

The youngest case operated on was seven years, the oldest fifty-seven years. The average length of time that elapsed between the shooting and operation was between 8 and 9 hours. The earliest case operated on was 3 hours, and the latest 36 hours after injury.

The smallest number of perforations was 2, and the largest 22. The average number of perforations for the entire series about 9.

In 5 cases the injury was confined to the upper abdomen (above the umbilicus), and in 3 other cases both lower and upper abdomen were involved. Of the 5 cases in which the upper abdominal cavity was the seat of injury, once there were two perforations only in the transverse colon, 3 times colon, stomach and liver were injured, and once spleen and stomach. Of the 3 in which both lower and upper abdomen was involved, twice, besides three perforations to the small intestines, both colon and stomach were injured, and in 1 case with two small intestinal holes both colon and spleen were penetrated. In the remaining 19 cases the projectile did not enter the upper abdomen.

The ureter was divided low down in 1 case and we have been fortunate enough not to have had any of the great trunk vessels injured except in 2 cases that died. In about 10 cases there was a very serious hemorrhage from the injured mesenteric vessels.

The element of shock was very much more marked in the white than in the colored cases, in more than half of the colored cases the amount of shock present was a negligible factor, while only 3 out of the 12 white cases were not in a condition of serious shock, there being 12 white and 15 colored cases.

The only certain way to determine whether or not perforations have occurred is by operation and this should be done in practically every case. There should be no surmising whether the bullet has entered the abdomen and produced perforation or not. This question should be settled by exploratory celiotomy. Contrary to the general belief our opinion is that one should not be too precipitate in operating on these patients. I do not wish to be misunderstood here, for certainly things being equal, the surgeon who operates promptly after injury, who gets into the abdomen and out of it quickly, will have the best results. There is a vast difference between an operation quickly done

ful case, but in a straightforward and comprehensive way, adv treatment of such cases by exploratory coeliotomy The paper of loch's is entitled to rank with the work of McGuire and Sims think it but just and fair to say that the paper of Dr McGuire be the Virginia Medical Society in 1873, the paper by Dr Sims in *British Medical Journal* in 1881, and the paper by Dr Kimloch in really established the operation and placed it on a safe and so surgical basis The principles laid down by them furnished the t of surgical work to-day

It is extremely interesting to note the reduction of mortality cording to Matthews, among the British soldiers in the Crimean V the mortality in penetrating wounds of the abdomen was 92.5 per and in the small per cent of recoveries the proof is not positive all wounds were perforating Chenu gives the mortality among French soldiers as 91.7 per cent Otis has collected 3717 cas gunshot wounds of the abdomen during the late American War gives the gross death-rate at 87.2 per cent, and in 2599 cases positive visceral injuries had taken place 92.2 per cent died In Mo han's "Abdominal Operations," 1914 edition, you find the foll paragraph

Dr Fetner (*ANNALS OF SURGERY*, vol xxxv, p 15) reports six cases of p trating wounds of the abdomen treated by operation and gives statistical of 152 cases treated at the Charity Hospital, New Orleans, between Jan 1892, and January, 1901 There were 96 cases of gunshot wound of the abd with visceral injury Of these 71 died—a mortality equivalent to 73.95 per c

Such a death-rate is, of course, appalling The mortality in operated on under modern conditions, such as the character of projectile, is considerably lower than those of the American V The most striking thing in the whole situation has been the gra lowering of the death-rate until now it is quite common in the lit to find series of cases operated on with the mortality ranging 15 to 25 per cent and in some instances possibly lower than this 3 per cent of all gunshot wounds received in battle involve the ab mal cavity, and about 0.8 per cent of abdominal wounds fail to in the intestines In other words, 0.8 per cent only of penetrating of the abdomen fail to produce perforation of either the hollow or viscera The question raised by this statement as to which cases be explored is so plain "that he who runs may read"

In December, 1907, at the New Orleans meeting of the Sc Surgical and Gynæcological Association, I reported a series of consecutive, unselected cases of penetrating and perforating

PERFORATING GUNSHOT WOUNDS OF THE ABDOMEN

time where the storage function is greatest, conditions are ideal for the multiplication of bacteria and the intestinal flora attain their greatest virulence. Wounds which involve both large and small intestine are particularly dangerous, especially is this true where the portion of big bowel involved is cæcum or ascending colon. When such an injury accompanied by extensive hemorrhage is present, all the conditions necessary for a rapidly developing peritonitis are at hand and the highest mortality can be expected.

Our practice is to bring the patient directly to the operating room, where he is warmly wrapped and prepared for operation. He is given enough morphine to keep him from suffering and to help him recover from shock. Unless the patient is in first-class shape, he is given intravenously one or two pints of normal salt solution. When it is not desirable to give the salt solution directly into the veins, it can be given subcutaneously. When a donor is available, the condition of hemorrhage and shock can best be met by a direct transfusion of blood. When everything is in absolute readiness, we allow, according to indications, a reasonable time in which the patient can react before making the incision. The median abdominal incision is chosen under ordinary circumstances for reasons obvious to all. A very important matter in these cases is to get a correct idea of the track of the bullet, for in this way one is occasionally able to save much time and avoid a great deal of unnecessary handling of vital parts. Particularly should we be careful in handling the abdominal viscera which are painless to the sense of touch. It has been shown very recently in a splendid article in the *British Journal of Surgery*, for October, 1914, by Charles A. Pannett of London, that "Afferent impulses resulting from manipulation of the viscera have in general a more pronounced effect on the vasomotor centre than those resulting from the opening of the abdomen and the retraction of the edges of the wound." It would seem, therefore, that the handling of the intestines, which is painless in the ordinary understanding of the term, is a more serious thing than handling of the parietal peritoneum and skin, which are extremely painful to injury. The principle, therefore, in all such work, should be as gentle manipulation as possible.

It is extremely important to make a careful and systematic search of the entire intestinal tract. Our practice is to begin at some fixed point, generally at the junction of the small and large intestine, and while it is most unfortunate generally all of the small intestine has to be inspected. The large bowel can be treated with greater liberty. When perforation is clamped as found and healthy intestine returned

and one that is hurriedly done. I am also satisfied in my own mind that anything like an extensive soiling with peritonitis does not and cannot occur within 4 or 5 hours and there is strong evidence to show owing to the paralysis of the bowel from the local and general shock of the trauma, that escape of intestinal contents does not occur markedly for 2 or possibly 3 hours. We are convinced, therefore, from a surgical point both practical and theoretical, that while operation should be promptly done, it should not be hurriedly done. I am on dangerous ground right here, the point I wish to make is this. Not all, but a few, of these cases, especially where shock is present and hemorrhage not serious, will be made safer surgical risks by allowing them a reasonable time in which to react from the primary effects of the injury. Already some one has raised the question, how are you going to differentiate between shock and hemorrhage. My answer is, it cannot always be done, but, to the thoughtful man with training and experience, he will be able quite frequently to make the distinction. To me this is one of the very vital points in the paper, for we are convinced that reasonable observance of this suggestion will occasionally turn the tide in our favor. After all, it reduces itself to a question of the surgeon's judgment, intuition and instinct of the individual operator.

Within limits that are reasonable, barring unusually severe injury, the ordinary case is a good surgical risk when operated on between four and twelve hours after the injury. Some one has made the statement that the elapse of 12 hours or more between the occurrence of accident and performance of the operation constitutes a contra-indication to operation. We take sharp issue with this statement, and, in support of the contention, submit the following. One case was operated on 24, one 36, one 18, two 12 and one 17 hours after injury and one of these cases died. This is considered a sufficient answer to the above. If a patient suffering from one of these injuries presents himself for operation and has only one chance in a thousand to recover under surgical treatment, he should be given that chance and any limit up to the point of the patient being moribund should be considered artificial.

Injuries above the umbilicus are more dangerous, harder to treat and have a higher mortality than injuries to the lower abdomen, injuries to the large bowel we believe to be more dangerous than injuries to the small bowel, and for this reason, the contents of the small intestine are fluid and move rapidly, the fecal current reaches the cæcum ascending colon where fluids are rapidly absorbed. The current comes very stagnant. In the cæcum and that portion of the large

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believe to be the dividing line between irrigation and non-irrigation. At any rate, it is the basis of our reasoning and furnishes justification for the practice, bearing in mind always, with the method described above, the cleansing of the cavity and removing of infectious debris can be accomplished without handling of the viscera or, what is even worse, pulling on the mesentery or without unnecessary loss of time.

We must also remember that hours and sometimes days will elapse between the onset of acute inflammatory process and the occurrence of perforation. All during this interval between the acute attack and perforation, nature is getting ready to take care of the perforation when it occurs. The whole natural armament has been called out. The peritoneal cavity is in a very real sense not taken by surprise, but is prepared for the attack. The omentum is on its way, the leucocytes, the turbid lymphatic exudate which we find in so many of these cases is purely a conservative process and in conjunction with the other helpers at hand in the great majority of instances will successfully localize the infection.

Dr Hunter McGuire and Dr Sims both insisted on drainage. In our humble opinion this was a profoundly wise judgment on their part. We drain every case. I do not wish to appear dogmatic, but the rule should be—when in doubt, drain. A Keith's glass drainage tube is placed through the angle of the median incision into the Douglas pouch, depending on conditions a small Keith's tube is so placed as to drain each loop. On the patients' returning to bed they are placed in the exaggerated Fowler position unless the patient is so weak as to contraindicate it. This position one can get very readily by using the ordinary hospital roller chair. The continuous rectal instillation of normal salt solution is practised unless the large intestine has been injured. We stress the point that it is necessary to be very careful about suturing any rent in the mesentery, as occasionally one can have through such a rent an incarcerated bowel with obstruction. About 5 per cent of these injuries die from tetanus, consequently on the first, fourth and sixth days after injury they are given an immunizing dose of anti-tetanic serum. If in the course of operation a segment of bowel is found with a number of perforations occurring close together, it will be conservative and occasionally life-saving to resect the intestine instead of suturing the individual perforation. Quite occasionally we have had recourse to this expedient.

In certain cases where one finds a portion of intestine of doubtful vitality, the patient's condition being extreme, a good thing has been found to bring such a piece of intestine into the wound, isolate it from

to the abdomen The large bowel is then gone over Quite it is evident from the direction of the bullet that inspection of the cavity would not be necessary, but this question must be left to surgical understanding of each individual surgeon

Whether or not to irrigate the abdomen is another point about which there is much difference of opinion In practically all cases in this series general irrigation of the abdominal cavity through a Blake's two-way irrigator was practised This instrument is so constructed that the entire cavity can be irrigated without losing any time whatever in operation or exposing the viscera to any unnecessary handling The position of the irrigator is simply changed from one point to another as desired We have never been able to see where it was harmful to gently irrigate the abdomen with hot normal salt solution in the presence of extensive infection The more diffuse the peritonitis the greater the necessity for irrigation The advantages to be gained by it are more than one and must be apparent to all of us Occasionally where there is very limited soiling, irrigation has been dispensed with

We do not practise irrigation in peritonitis from any other source The question has been frequently asked, why do you irrigate in gunshot wounds of the abdomen and do not irrigate, for example, in a case of peritonitis from a ruptured appendix? This is a fair question and the answer is as follows In a case of peritonitis from a ruptured appendix there is, as a general rule, one orifice from which the infection comes The soiling process is much slower and nature has a much greater opportunity to successfully localize and combat the spreading infection There is, we believe, an unmistakable tendency towards the localization of the infected area in peritonitis coming from this source Owing to the relative smallness of the peritoneal soiling, the natural forces working in the patient's behalf, to wit, his opsonins, his leukocytes, his resistance and ability to overcome the infection and develop immunity are far greater than, for example, in a gunshot wound of the abdomen that penetrates transversely the abdomen, opens the intestinal tract in possibly twelve or fifteen places, which will surely in a short while turn loose an overwhelming amount of infectious material into the peritoneal cavity While such a patient does not develop the full meaning of the word, a general peritonitis at once, he will very promptly have a general soiling of the cavity To put the matter in a sentence, nature has a chance in one instance against what is a very small chance in the second instance In the first case, she can cope for a limited amount of soiling, in the second case the infectious material is so great that she is overwhelmed

FRACTURE OF THE PELVIS

SYMPTOMS AND CLINICAL COURSE FROM A STUDY OF TWENTY-NINE CASES

BY A CAMPBELL BURNHAM, M D.

OF NEW YORK CITY

A RECENT publication by Jensen has drawn attention to the fact that fracture of the pelvis occurs more commonly than is generally supposed and forcibly impresses upon the surgeon the necessity of painstaking examination in doubtful cases of injury in the region of the pelvic bones, the examination to include the use of the X-ray in every case where trauma has been followed by pain referred to the pelvis, even in those cases where the pain is only moderately severe

Jensen, working in Copenhagen, was able to collect 80 cases from the records of four general hospitals, covering a period of a little over five years. He lays special emphasis on the fact that many cases were unrecognized until long after the injury and that, owing to the supposed rarity of this condition, it was frequently overlooked even in patients who were under hospital treatment from the first. It was the desire to ascertain the comparative frequency of this condition in America, as well as to correlate Jensen's statistics with figures obtained from local records, that has led to the preparation of this paper.

The cases upon which the statistics presented herewith are based are taken from the hospital records of the surgical division of a New York City hospital¹ during a period of a little over six years, from February, 1906, to March, 1912. They represent the cases admitted to the hospital wards, but do not include a few cases which ended fatally, either shortly after the accident or in the emergency ward of the hospital within a few hours after admission.

Some idea of the frequency of fracture of the pelvis may be obtained when it is known that during the same period 143 cases of fracture of the femur and 16 cases of fracture of the vertebrae occurred. In other words, from the records of the Presbyterian Hospital, it would appear that fracture of the pelvis occurs about one-fifth as often as fracture of the femur and about twice as often as fracture of the vertebrae.

In Jensen's 80 cases there were 55 clinical cases and 25 which were taken from autopsy records, in the latter group were many cases in

¹From the surgical histories of the Presbyterian Hospital, New York City. My thanks are due to the attending surgeons for permission to study these records.

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the rest of the peritoneal cavity by gauze sheets, leaving it here in a position to watch until such time as it can be repaired should it become necessary. It is better to assume this risk than to force an already taxed patient to stand a prolonged operation that may be fatal.

The late Dr. Homans, of Boston, once said that nine out of ten knew what to do, but the tenth man knew what not to do. This statement is never more applicable than in relation to the subject under discussion.

As to the length of time to be occupied in these operations, these cases should be operated on just as quickly as is commensurate with thorough and careful work and no quicker. While the work should be rapidly done, it should not be hurriedly done, for there are other questions at stake and other things to be considered than the number of minutes taken to do the work.

FRACTURE OF THE PELVIS

In the discussion of the different types of fracture, Jensen classifies separately those cases which come to autopsy, and the clinical cases. His results are shown by the following

Autopsy cases (total 25)

(a) Fracture of single bones

Sacrum	1 case
Ilium	1 case
Ischium	6 cases

(b) Multiple fracture of the pelvic ring

Double vertical (Malgaigne)	7 cases
Fracture and luxation	9 cases

(c) Luxation 1 case

Clinical cases (total 55)

(a) Fracture of single bones

Sacrum	1 case
Ischium	1 case
Acetabulum	5 cases
Pubis	22 cases
Ilium	9 cases
Pubis and ischium	7 cases

(b) Multiple fracture of pelvic ring

Double vertical (Malgaigne)	2 cases
Luxation and fracture	6 cases

(c) Luxation 2 cases

It may be noted from the above that the multiple fractures are much more frequent among the autopsy cases. This is due, in part, to incomplete diagnoses in the clinical cases, but chiefly to the fact that cases coming to autopsy have suffered a much greater trauma than have the majority of the clinical cases.

In the present series, the division of cases was as follows

(a) Fractures of single bones.

Ilium	9 cases
Pubis	8 cases
Ischium	1 case

(b) Multiple fractures of the pelvic ring

Double vertical	5 cases
Luxation and fracture	2 cases

(c) Luxation 1 case

In the present series three cases were compound, and the remainder were simple fractures.

The age seems to have little influence. Seven cases were under twenty years, twenty-one cases between twenty and fifty years and one case was seventy-two years old.

Corresponding with their more active life men showed the greater liability to fracture of the pelvis (males, 21 cases; females, 8 cases).

which the fracture of the pelvis was undiagnosed because the tant lesions (cerebral hemorrhage, intra-abdominal injuries, etc.) usually so severe as to overshadow the symptoms referable to the . If we exclude cases of this type, which, owing to the pa post-mortem examinations in America, are frequently un. then Jensen's cases are, in the main, similar to the present series may be fairly compared with them

Fractures of the pelvis may be single or multiple a whether one or more bones are broken Fractures of the single occur most frequently and may, or may not, involve the true r The common type of these fractures is that which includes those in ing the crest of the ilium, which, owing to its position, is fre. exposed to trauma Fractures passing through the pubis and the obturator foramen are considered as single fractures bec pelvic ring is broken in only one place, although in the fractures ing through the foramen, the line of fracture may pass throu ramus of the pubis above and the ramus of the ischium below

Multiple fractures, on the other hand, usually signify that of fracture passes through the pelvis at two points, either the and pubis, the pubis and sacrum, the rami of the pubis on both of the midline, or other combinations Fracture with separation sacro-iliac synchondrosis or symphysis clinically falls under the group as multiple fracture and is classed with it Indeed, the bination of separation of the sacro-iliac joint and fracture obturator foramen is one of the most common types of multiple ture The sacro-iliac separation, moreover, is usually not a tru articulation but is associated with fracture of the sacrum, or both, the line of separation passing downward through the ilium synchondrosis and continuing through the bones, or, in some branching through the sacrum

An unusual fracture of the pelvis which deserves special is that of the acetabulum This may consist of fracture of the the acetabulum or the fracture of its floor, and is due to a transmitted through the head of the femur. The force may b cient to drive the head of the femur through the floor of the into the true pelvis Skillern and Pancoast have reported of fracture of the floor of the acetabulum, in three of which of the femur was well within the pelvic cavity

Fractures of the coccyx were not included in the present because they form a separate class which has little in other fractures of the pelvis

FRACTURE OF THE PELVIS

no deaths. The longest time spent in bed was 38 days, and the average time in bed was 27 days. Except in the two operative cases (Cases 12 and 25) the treatment was merely rest in bed with palliative measures toward the relief of pain.

Fractures of the Pubis and Ischium—The fractures of the pubis and ischium may be conveniently discussed together. This is especially true because isolated fractures of the body or tuberosity of the ischium did not occur in this series. Fracture of the body of the ischium may occur in fracture of the floor of the acetabulum as previously described. Berry has reported an interesting fracture of the tuberosity which was caused by muscular action. Jensen reports that in his series of cases there was no fracture of the tuberosity of the ischium. The findings in the present series agree with his. Such a fracture must be extremely rare.

The line of fracture in this group of cases passes either through the body of the pubis (two cases) or, as is more common, through the thin ramus above and below the obturator foramen. The mechanism of the fracture in most cases appears to be a combination of direct violence and compression, the pelvis, being exposed to a considerable force, breaks at the point of impact. However, the pressure may be so applied as to compress the pelvis from side to side, rather than anteroposteriorly, and in these cases the fracture of the pelvic ring occurs at its weakest point in a manner analogous to the "bursting fractures" of the skull.

The etiological trauma in fractures of the pubis and ischium is usually greater than in fractures of the ilium. In six cases the injury was due to a crushing force applied to the pelvis, such as a weight falling upon the body in the region of the pelvis (three cases), or an injury caused by the wheel of a vehicle passing across the pelvis (three cases). Only one patient included in this group was able to walk and in that case the patient walked only a short distance. The shock and abdominal symptoms were, as a rule, more pronounced than in the previous group.

Complications were much more frequent in this group than in the previous one. In five cases there were other fractures present and in six cases there were complications referable to the genito-urinary system. Abdominal complications were not frequent but in one case an extraperitoneal hematoma was so extensive that operative interference was required.

Operation was necessary in only three cases. The first was the laparotomy mentioned above in which exploratory cystotomy was done.

Fracture of the Ilium—The ilium was more frequently fractured than any other bone. Isolated fracture of the ilium occurred in cases of the present series. Fracture of the ilium was frequently the result of trauma of only moderate severity. Three cases were caused by moving objects and two others fell from vehicles.

In Case 2, a fireman, while hurrying to a fire, ran into a lamp post. The blow was received with greatest force in the region of the right hip. He was able to walk a short distance, but the pain became so severe that he was obliged to send for an ambulance. Another patient, also a fireman, was struck in the hip by a wagon. He did not consider his injury especially severe, and continued to walk back to the fire house. Later the hip became stiff and painful. The patient applied for treatment. In one case of this series (Case 25), the fracture was due to muscular violence. The patient, a young man of seventeen years, was running a race. He suddenly felt a sharp pain in the region of the hip and was obliged to stop. Examination showed a fracture of the anterior superior process of the ilium with a moderate amount of separation. This type of fracture must be very rare, there was no instance of it in the 80 cases collected by Jensen, and I have been able to find no other in the hospital records. Bebee collected four cases of this type of fracture from the literature.

As has been mentioned before, the symptoms of this injury are sometimes insignificant. Three of the patients were able to walk after the injury, and the diagnosis of fracture was made only through X-ray examination. The symptoms were obscure and in a few cases could be distinguished only with considerable difficulty from a fracture of the neck of the femur. Crepitus was frequently obtained. In several cases the fragment could be grasped between the fingers and moved freely. Ecchymosis was usually early and extensive. It must be emphasized that crepitus, false point of motion, and ecchymosis may all be absent in the presence of an extensive fracture of the ilium.

Serious complications are the exception in fractures of the ilium. Four cases were uncomplicated. In one case (Case 8) the fracture was compound. Subcutaneous hæmatoma occurred in three cases, one of which was infected. Abdominal complications (laceration of the peritoneum and tery and peritoneum) occurred in only one case. Complications involving the genito-urinary tract were also present in one case, but required no special treatment.

Only two patients required operation, and in one of these (Case 10) the operation was confined to the radical reduction of the fracture. In the other, the operation was a laparotomy with the repair of the peritoneal lacerations. The prognosis of this type of fracture is good. Eight cases were cured and one case discharged improved. Th

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was no longer considered necessary. Two patients died within 48 hours of the accident, neither of them recovering from the primary shock. In the entire series, there was no death from late complications, each of the three deaths occurring within a short period after the accident.

Symptoms of Fracture of the Pelvis—Besides the local symptoms of fracture of the pelvis, there are a number of fairly constant associated symptoms which may conveniently be discussed together. These may be classified as general, abdominal, and those referable to the genito-urinary system.

The general symptoms are often overshadowed by those of the concomitant lesions, but even in uncomplicated cases, the shock is often severe. Death from the immediate effects of an uncomplicated fracture of the pelvis is rare. Jensen had only one case, a woman eighty years old, in whom death followed as a direct result of fractured pelvis. In the present series there was one patient who went into sudden collapse shortly after the accident (bleeding into the abdomen was suspected but an exploratory laparotomy was negative), no cause for the fatal issue being determined except pelvic fracture and acute alcoholism (Case 24).

In eight cases shock was severe and of considerable duration. In thirteen cases shock was of moderate severity and in the remaining cases there was only slight transient shock or none at all.

These latter cases are of extreme importance. It is not sufficiently appreciated that patients may have a fracture of the pelvic bones and still be able to walk and suffer little or no general inconvenience. Jensen reports cases in which the diagnosis was not suspected until months later when the patient came to the hospital for relief of permanent disability, the diagnosis of the fracture being finally made by means of the X-ray, much to the surprise of his physician who had been treating him for "traumatic sciatica" or "neurasthenic spine" or some other equally indefinite complaint.

Of the other general symptoms, fever was the most common. A temperature rising above 102 was present in 10 cases and a lower degree of temperature (between 100 and 102) was present in 13 cases. It is practically the rule in these cases to have some rise in temperature after the injury. The usual course is for the temperature to reach its highest point on the day after the injury and to fall gradually to normal in from six to ten days. In six of the ten cases in which the temperature was 102 or over the high temperature indicated a complication. In the other four cases there was no apparent cause for the fever except the fracture itself.

for a suspected rupture of the bladder, the second case was an operation for traumatic rupture of the bladder and urethra, while the third consisted merely in the incision of a superficial hæmatoma.

There was one fatal case in this group, a child in whom the fracture of the pelvis was compound and associated with a traumatic amputation at the hip. Four cases were discharged improved and the remainder left the hospital "cured." Of the "cured" cases, the longest in bed was 57 days and the average period of treatment was 43 days, a period considerably longer than is the case in the fracture of the ilium.

Fractures of the sacrum may be mentioned here. There is none in the present series, but the lower sacral vertebræ may be fractured in the same manner as the coccyx. Jensen found two cases in his series. They may be rarely associated with the crushing injuries of the pelvis.

Multiple Fractures of the Pelvic Ring—In this group there were seven cases, five of which were double vertical fractures, the remainder being fracture associated with luxation. What has been said regarding the mechanism of fracture of the pubis and ischium applies here as well, except that the trauma in these cases is usually more severe. In five cases of this group, the injury was caused by a fall from a height of from one to four stories. Two crushing injuries, a child, was run over by a heavy wagon, and the other, an adult, caught beneath the trunk of a falling tree. As would be expected, none of these patients were able to walk, but in one case (Case 27) the amount of shock was slight in proportion to the injury.

Complications occurred in every case of this group. Complications of the genito-urinary system occurred in two cases and complications referable to the genito-urinary system in five cases. One patient (Case 28) died a few days after admission and developed a septic temperature which lasted about two weeks.

Two cases came to operation, in one of which there was an exploratory operation upon the urethra accompanied by the operative repair of the fracture. The second operation was an exploratory laparotomy for abdominal symptoms (Case 24) the cause of which was not determined.

Only one case remained in the hospital until able to walk. In this case the patient was in bed for a period of 61 days. In two of these the patients were discharged improved. In two of these the accidents occurred in attempting suicide and they were transferred to a hospital for their mental condition. Two other patients were discharged to their homes for further treatment at home. All of these cases, when transferred, were in good physical condition and were moved because active.

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has for its basis rest in bed in the position of greatest comfort. The treatment has been divided by Steinthal as follows

- 1 Treatment of the shock
- 2 Treatment of the fracture by the reduction of the fractured bones, and their retention by means of sand bags, posture, etc
- 3 Treatment of complications

This third division should be subdivided to include the treatment of the early complications and the prevention and treatment of late complications

The manual reduction may be accomplished in some cases by means of the finger introduced into the rectum or vagina. In selected cases, open reduction may be indicated. This is especially true in young women who may find in a badly united fracture a severe handicap to normal parturition. In double vertical fracture where almost the entire innominate bone is displaced upward and outward, a Buck's extension applied to the affected side may aid in securing the reduction of the fragment. The same apparatus may act for the relief of pain in fractures involving the acetabulum.

The duration of treatment depends upon the type and severity of the fracture. Fractures of the crest of the ilium may be allowed up after three weeks, while fractures of the pelvic ring should be kept in bed for at least six weeks or longer. In the severe types of fracture including the double vertical fracture, the patient should be kept at rest for a much longer period, eight or ten weeks or even longer. Most of the present series of cases left the hospital as soon as they were allowed to walk, the hospital treatment representing only the period of complete disability during which the patient was confined to bed. After leaving the hospital there is a long period of partial disability during which the pelvis may be supported by adhesive strapping, tight leather or elastic supports or other like appliances.

Still later symptoms due to the formation of an excessive amount of callus or the involvement of the sciatic nerve of the callus formation may indicate operation.

Prognosis—The prognosis as regards life in uncomplicated cases is good. As has been previously noted, less than one per cent end fatally. As regards the permanent return of function the prognosis is less satisfactory. Steinthal cites the figures given by the Austrian insurance companies. They consider that, even in bony union, the permanent injury to the adult earning capacity varies from 10 to 50 per cent. In cases where the union is fibrous the permanent injury to the earning capacity is usually as high as 60 per cent.

Abdominal symptoms were present in nearly every case. This is easily understood because of the wide attachment of the abdominal muscles to the pelvic bones. There are few pelvic fractures which are not, in some way, influenced by the tension of the abdominal muscles, and consequently a greater or less degree of rigidity, upon the injured side and of the group of muscles involved, is to be expected. Abdominal symptoms were marked in nine cases. Of these, four were operated upon and in two the condition was so bad that operation was not attempted.

In 17 cases the abdominal symptoms were moderate or slight, while there is frequently a certain degree of rigidity, the tense board-like rigidity of inflammatory type is usually absent. In this connection a certain degree of conservatism is in order, and it is necessary to remember that a moderate or even marked degree of abdominal tenderness is not in itself a sufficient indication for laparotomy.

From a clinical point of view, the complications referable to the genito-urinary system are the most interesting and the most important. Of this series, excluding one case in which abortion followed the injury, there were 11 cases (38 per cent) in which there were symptoms referable directly to the genito-urinary tract. In these, hæmaturia occurred alone in four cases, and retention of urine occurred in two cases. In five cases dysuria occurred, the catheterized urine being mixed with blood. The interesting fact in the above is, that of the cases showing either hæmaturia or retention of urine or both, there were only three operations and one death. The fatal case (Case 10) although showing definite symptoms of rupture of the bladder, was in such bad condition that no operative procedure was permissible. In the remaining nine cases, three were operated upon, in one of which (Case 9) exploratory cystotomy was negative. In two cases (Cases 11 and 19) operative procedure was indicated and successfully carried out. From the above it is apparent that rupture of the bladder or urethra (occurring 3 times in 29 cases) is a less common complication of fracture of the pelvis than is generally supposed. Moreover, it would appear from a study of the case histories, that both hæmaturia and retention may be present after the injury and persist for several days or longer without indicating the necessity of operative intervention. The discussion of the indications for operation and the details of operative procedure to be followed is not permissible within the limits of the paper, they are, however, of extreme importance.

Treatment—The treatment of uncomplicated fracture of the

FRACTURE OF THE PELVIS

TABLE II—Continued

Fracture of the Body of the Os Pubis

Case No.	Sex, Age Etiology	Complications	Genito-urinary Symptoms	Operation	Days in Bed	Result
14	M 42 years Fell 6 feet	None	None	None	16+	Home against advice
18	F 42 years Fell 1 story	None	None	None	57	Cured

TABLE III

MULTIPLE FRACTURE OF THE PELVIC RING Double Vertical Fracture

Case No.	Sex Age Etiology	Complications	Genito urinary Symptoms	Operation	Days in Bed	Result
11	M 40 years Hit by falling tree		Retention of urine, rupture of urethra, cystitis, pye- litis	Suture of bone, urethror- rhaphy, exter- nal urethrot- omy	61	Cured
16	F 23 years Jumped three stories	Fractured humerus, psy- chosis	None	None	21+	Transferred
17	M 34 years Fell 15 feet	Alcoholism	Hematuria	None	21+	Transferred
23	M 4 years Run over by wagon		Hematuria, re- tention of urine, rupture of bladder	None	2	Died
24	M 35 years Fell from roof of stable	Fracture of ribs alcoholism	None	Exploratory lap- arotomy	2	Died

Luxation and Fracture

Case No.	Sex, Age Etiology	Complications	Genito Urinary Symptoms	Operation	Days in Bed	Result
7	M 36 years Fell 1 foot	Prostatic hema- toma	Hematuria	None	11+	Transferred
21	F 32 years Fell 4 stories	Psychosis	Endometritis abortion	None	47+	Transferred

Luxation of Symphysis

Case No.	Sex, Age Etiology	Complications	Genito-urinary Symptoms	Operation	Days in Bed	Result
22	F 32 years In- voluntary fall	None	None	None	51	One-half infection retention discharge

A CAMPBELL BURNHAM

TABLE I FRACTURE OF THE ILIUM

Case No	Sex, Age, Etiology	Complications	Genito-urinary Symptoms	Operation	Days in Bed	R
1	M 47 years Struck in hip	None	None	None	38	Cu
2	M 27 years Ran against post	None	None	None	20	C
3	M 24 years Struck in hip by automobile	None	None	None	9+	T
8	M 45 years Fell from carriage	Subcutaneous hæmatoma, compound fracture	None	None	29	C
10	M 22 years Fell from wagon	Subcutaneous hæmatoma	Retention of urine, hæmaturia	None	28	C
12	M 11 years Run over by wagon	Traumatic laceration of mesentery and peritoneum	None	Laparotomy and repair of lacerations	9+	Cu T fe
15	F 4½ years Hit by wagon	Infected hæmatoma	None	None	32	Cu
20	M 25 years Fell three stories	Fracture of ribs	None	None	28	C
25	M 17 years Sudden pain in hip while running	None	None	Radical repair of fracture	32	Cu

TABLE II FRACTURE OF THE PUBIS AND ISCHIUM Fracture Through the Obturator Foramen

Case No	Sex, Age, Etiology	Complications	Genito urinary Symptoms	Operation	Days in Bed	R
4	F 7 years Run over by automobile	Traumatic amputation of hip, compound fracture	None	None	1	D
5	M 8 years Run over by wagon		Hæmaturia	None	10+	H a
6	M 72 years Fell 8 feet	Double Colles's fracture	None	None	30	C
9	M 26 years Fell three stories	Prevesical hæmatoma, laceration of peritoneum, bed-sore	Hæmaturia, cystitis	Exploratory laparotomy, and cystotomy	35	C
13	M 47 years Fell 15 feet	Colles's fracture, contusion of chest, hæmoptysis	None	None	2+	H a
19	M 28 years Fell 12 feet, beam fell across abdomen	Fracture of ribs	Rupture of bladder, rupture of urethra, cystitis, pyelitis, retention of urine	Perineal and suprapubic cystotomy, repair of bladder and urethra	55	C
21	M 11 years Run over by automobile		Hæmaturia, retention of urine	None	4+	T
22	M 33 years Concrete, fell on pelvis	Infected hæmatoma	Hæmaturia, retention of urine	Incision of hæmatoma	45	C
26	F 35 years Horse fell on abdomen	None	None	None	30	~
29	F 35 years Fell 1 story	Fracture of ribs, Colles's fracture	Retention of urine, pyelitis, cystitis	None	51	~

SIMULTANEOUS FRACTURE OF BOTH FEMURS

ONE TREATED BY PLATING, THE OTHER BY EXTENSION AND PLASTER-OF-PARIS CAST¹

BY ALBERT VANDERVEER, M D

AND

EDGAR A. VANDERVEER, M D.

OF ALBANY, NEW YORK

PATIENT, a man, fifty years of age, of good habits and fine muscular development, was brought to the Albany Hospital, October 29, 1912, having sustained, at the same moment, a comminuted fracture of each femur as the result of having been pinned between the side of a house and the rear of a heavily loaded wagon. The skiagraphs (Figs 1 and 2) show the condition of the respective femurs on admission. It was decided to reduce the fractures under anæsthesia, and to apply a plate to the right bone and for the left to use extension and a plaster-of-Paris cast. This was done upon the day of his admission after a few hours of rest, about four o'clock in the afternoon.

The patient was under the anæsthetic a little over two hours. Owing to his exhausted condition it was not thought wise to take him to the X-ray room for other skiagraphs, but to remove him to his bed as quickly as possible. His case was one of some anxiety for the following twenty-four hours, when he reacted nicely and made an excellent recovery. The wound made by the plating operation healed kindly and without any complication whatever. The plaster bandage becoming somewhat loose was removed from the left leg December 17, 1912, an X-ray picture taken (see Fig 3), and limb found to be in excellent apposition. Fig 4 shows appearance of right leg on same date. By careful measurement, from the umbilicus, there was, perhaps, one-quarter inch shortening of the left femur. Plaster bandage reapplied to left leg, and aseptic dressings, with bandage, to right leg renewed. The patient was out of bed at the end of nine weeks, in a Morris chair, and encouraged to flex the knees and to begin the use of crutches, but this he found a very slow, painful process. There seemed to be a serious lack of confidence on his part in using the crutches, the fear of falling and not being able to bear much weight was very marked. February 25, 1913, plaster bandage removed from left leg, and there was evidence of good, firm union. Simple dressings applied, with bandage from the toes up, and the

¹ Read by title before the American Surgical Association, April 11, 1914

Pain, weakness, and a certain degree of lameness often persist long time after the injury. There is occasionally seen a chronic condition of invalidism similar to that seen after injuries to the spine.

The accompanying charts give in tabular form the causes, conditions, and results of treatment in the different groups of cases, classified according to the character of the fracture. The diagnosis was clinically, usually with the aid of the X-ray. In one case, the graph did not show a fracture although the clinical symptoms absolutely typical. In the remaining cases radiographs were positive but it is possible that in some cases the diagnosis was insufficient, while a fracture of one bone was clearly demonstrated an associated lesion in another bone, or in another portion of the same bone, not be positively excluded. In other words, some cases diagnosed as fracture of a single bone were possibly multiple fractures. This should be borne in mind in studying the tables and due allowance for individual variations.

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Fig. 1—Left femur



Fig. 2—Right femur



patient then began the use of crutches with more earnestness time he found that one limb would support him quite as well as the other, using the crutches for two or three weeks, then two finally, one cane. The latter was given up in October, 1911, year after the time of the accident. Since then he has walked very comfortably, with full confidence, and scarcely a perceptible limp, giving full attention to his occupation as Chief of Inspection in the New York State Department of Education.

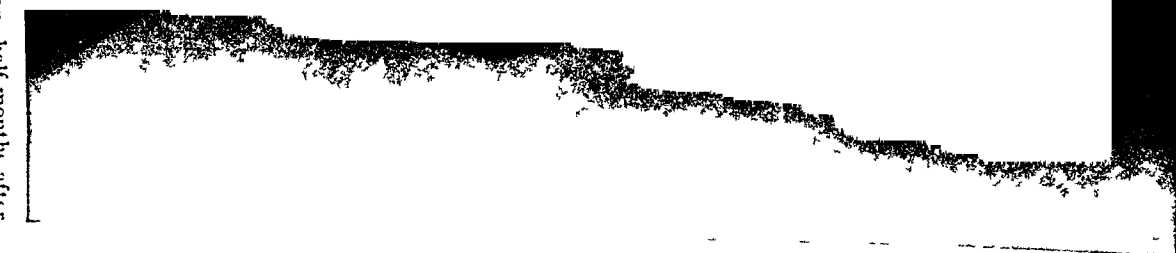
April 10, 1914, the X-ray pictures present fully the condition regarding the appearance of the right leg (see Fig. 5) and (Fig. 6) of the left. In the latter, it will be noticed, there is a decided bending at the point of union, yet the patient is able to walk comfortably.

April 18, 1914, photographs were taken, from a side view showing one limb to be about as straight as the other, while the anterior view (Fig. 7) shows a decided bowing outward of the left femur. A posterior view shows the bending even more markedly.

The last two X-ray pictures, together with the photographs of the left leg, demonstrate quite clearly that consolidation of the left leg has not been quite perfect, and that there has been a gradual giving away at the point of union, *i. e.*, a bending of the femur a long time after the patient was able to walk.

From this one case it is pretty positively shown that the union was secured in the right femur by means of plating, extension and use of plaster of Paris for the left leg.

Is it possible that the X-ray shadow gives an exaggerated view of the deformity of the left femur? At the point of union, there will be noticed a distinct separate enlargement, as there might be the remains of the metal plate. On careful examination the patient has no pain nor can any sensation of a foreign substance be recognized.



AUTOGENOUS BONE GRAFTS VERSUS LANE'S PLATES

By HUGH H. TROUT, M D
OF ROANOKE, VA

DUE largely to the efforts of W Arbuthnot Lane there has been a renewal on the part of surgeons to coaptate fractures by means of foreign material and, while doubtless much good has been derived from such a procedure, there has been done an untold amount of damage. Such apparently easy mechanical principles have tempted many an ill-prepared operator to approximate fractures in which he would have previously employed far more conservative methods with less harm to his reputation and a great deal more comfort and satisfaction to his patient.

In reading the history of any buried material in the human body it is interesting to note how, in the process of surgical evolution, we return to either no buried material at all, or at least an absorbable material if anything is absolutely necessary. Personally, I do not believe any metal plate is going to be an exception to this general rule, and further think Lane's plate and all such heavy metal appliances to be buried, will soon be in disfavor except in the very exceptional cases.

During the past year there has been widespread dissatisfaction due to the troubles many surgeons are having with Lane's plates and we believe this is the result of trying to apply a wrong surgical principle to a general class of cases.

Inquiry made and replies received from over one hundred surgeons in America, reveal that all, with the exception of seven, have had to remove Lane's plates either in their own cases or those of some other surgeon. This shows clearly one of two conditions—either the Lane plate is wrong or the surgeons have applied it incorrectly. Personally, we believe it to be the former, but if it be the latter then we must understand more thoroughly the principles underlying the success of Lane's individual cases.

Great stress is laid by Lane on not allowing the fingers of the gloved hand to touch the plate and we all admire the manner in which he handles his plate with his special devised instruments, but such dexterity is not given to many. It does seem to us a plate which is aseptic will remain so if handled with an aseptic glove, and certainly the average



FIG 7—Anterior view showing bend in left femur

AUTOGENOUS BONE GRAFTS VERSUS LANE'S PLATES

- 16—Staphylococci and a few *B. pyocyaneus*
- 17—Gram-negative bacilli and a few Gram-positive bacilli and cocci
- 18—*B. coli*
- 19—Gram-negative bacilli and a few cocci
- 20—*B. pyocyaneus* and a few cocci
- 21—Staphylococci, streptococci, a Gram-negative bacillus, probably *B. coli*, and Gram-positive bacilli
- 23—Staphylococci, streptococci, and a few *B. pyocyaneus*
- 24—Gram-negative bacillus, a few cocci, and Gram-positive bacilli
- 25—Staphylococci and *B. pyocyaneus*
- 27—*B. coli*, *B. pyocyaneus*, and a few streptococci
- 40—*B. pyocyaneus*
- 41—*B. pyocyaneus*
- 42—*B. pyocyaneus*
- 43—Staphylococci and *B. pyocyaneus*
- 44—*B. coli* and *B. pyocyaneus*
- 45—*B. pyocyaneus* and a few staphylococci

We next determined to ascertain the fate of an autogenous graft placed through an infected field in the same manner in which we had inserted our screws. The manner of obtaining the graft was simply to remove a small piece of bone and transfer it to the other leg—in other words, to take from the left and place on the right, and from the right and place on the left.

In this series we employed 25 rabbits, 3 of which died from ether, leaving a series of 22 rabbits having 44 grafts. Five of the bone grafts worked out (No. 50 right, No. 55 left, No. 60 left, No. 81 right, No. 87 right) while in the remaining 39 the grafts all apparently "took" and were found in place by X-rays and later on autopsies.

The grouping according to bacteria is as follows:

BACTERIA FOUND IN RABBITS HAVING AUTOGENOUS GRAFTS

- 49 Right—*B. coli*, *B. pyocyaneus*, and a few cocci
Left—*B. coli* and *B. pyocyaneus*
- 50 *Right—*B. pyocyaneus*
Left—*B. coli*, *B. pyocyaneus*, and streptococci
- 51 Right—*B. coli*, *B. pyocyaneus*, and a few Gram-positive bacilli, with metachromatic granules
Left—*B. pyocyaneus*
- 52 Right—*B. pyocyaneus*
Left—*B. pyocyaneus*, *B. coli*, and staphylococci
- 53 Right—*B. pyocyaneus* and staphylococci
Left—*B. coli* and *B. pyocyaneus*
- 54 Right—*B. coli* and *B. pyocyaneus*
Left—*B. pyocyaneus* and a Gram-positive bacillus
- 55 Right—Staphylococci and *B. pyocyaneus*
*Left—*B. pyocyaneus* and a few cocci

surgeon will cause less trauma to tissues with his hand than with steel instruments

No attempt will be made to explain why callus forma much more active on the side of a fracture opposite to a but such is a well-known fact to every surgeon Figs 1 and serve to show two of our worst cases, in both of which the removed with gratifying results

A few months ago we completed, with the assistance of Foster and E T Brady, some experimental work on Bel Our first two series of animals were used to show the res hand of small vanadium steel screws in the presence of inf on the other the behavior of autogenous grafts under s instances Thirty-five rabbits were employed to illustrate when screws were inserted in the presence of infection, a the autogenous grafts

The first 5 were injected with a culture of colon bacillus graphite In this series we only obtained three abscesses these three we made an incision through the abscess to th placed a small Vanadium steel screw in the femur In screws finally came to the surface and were removed in 6, days respectively With the rest of this series we gave up trying to develop a certain type of abscess and decided to an incision in the rabbit's thigh in as dirty a manner as thus obtain an infected field through which to place our at the same time we obtained a culture to ascertain the type producing the infection This was carried out in 30 r following results Six rabbits died from the anæsthetic (24 which had screws placed in either tibia or femur In 2 (12) the screws remained in position after developing sinu which finally closed, and in the remaining 22, all the scre the surface and were removed

This series according to the type of infection is as foll

BACTERIA FOUND IN RABBITS HAVING SCREWS INSERTED

- 1—B pyocyaneus and a few Gram-positive diplococci
- *6—B coli and a few Gram-positive diplococci
- 7—Staphylococci, streptococci, and a Gram-negative bacillus
- 8—B pyocyaneus and streptococcus
- *12—Staphylococci, streptococci and Gram-negative bacillus
- 13—Staphylococci, streptococci and a few Gram-negative b^a cyaneus
- 14—B pyocyaneus and staphylococci
- 15—B coli and staphylococci



FIG 1—Ununited fracture of femur due evidently to the Lane plate. A six months after removal of Lane plate. B six months after insertion of Lane plate. C one week after insertion of Lane plate. Taken with portable X-ray.



FIG 2—Ununited fracture of femur due to Lane plate. No see back of callus in region of Lane plate. A three months after insertion of Lane plate. B three years after removal of Lane plate. C three years after removal of Lane plate.

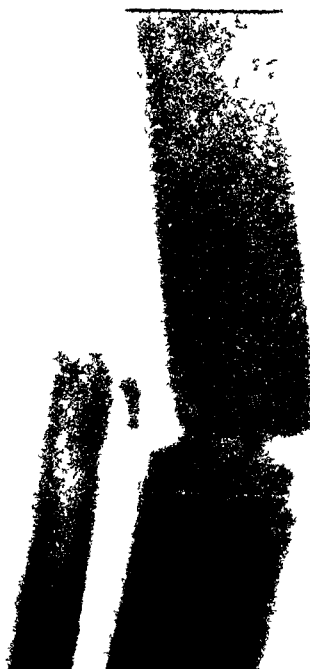
- 56 Right—B pyocyaneus and a few Gram-positive bacilli
Left—B pyocyaneus and a few Gram-positive bacilli with metallic granules
- 57 Right—B pyocyaneus
Left—B pyocyaneus and a few Gram-positive bacilli with metallic granules
- 58 Right—B pyocyaneus
Left—B pyocyaneus
- 59 Right—B pyocyaneus and a few Gram-positive bacilli with metallic granules
Left—B pyocyaneus and a few staphylococci
- 60 Right—B pyocyaneus and a few Gram-positive bacilli with metallic granules
*Left—B pyocyaneus and a few Gram-positive bacilli with metallic granules
- 75 Left—A Gram-negative bacillus
Right—Gram-positive and Gram-negative bacilli and a few cocci
- 76 Left—Large Gram-positive bacillus, Gram-positive diplococci, Gram-negative bacillus
Right—Staphylococci and Gram-positive and Gram-negative bacilli
- 77 Left—Staphylococci, Gram-negative diplococci, and Gram-positive bacilli
Right—Gram-positive bacillus and staphylococci and Gram-negative bacillus
- 80 Left—B coli, staphylococcus aureus, and a Gram-positive bacillus
Right—Staphylococci, Gram-negative bacillus and diplococci, Gram-positive bacillus
- 81 Left—B coli, Gram-positive diplococcus and a few Gram-positive cocci
*Right—Staphylococcus aureus, and Gram-positive and Gram-negative bacilli
- 87 Left—Staphylococcus aureus and Gram-positive bacillus
*Right—Staphylococcus and Gram-positive bacillus
- 88 Left—Staphylococcus aureus, Gram-positive bacillus and Gram-negative diplococci
Right—Staphylococcus aureus and Gram-negative diplococci
- 89 Left—Staphylococcus aureus and a small Gram-positive bacillus
Right—Gram-positive bacilli (white and yellow colonies)
- 90 Left—Gram-negative bacillus and Gram-positive bacilli and cocci
Right—Little growth, Gram-negative bacillus
- 91 Left—Staphylococcus aureus, Gram-positive and Gram-negative cocci
Right—Staphylococcus aureus and large Gram-positive cocci

In other words, in these infected cases 92 per cent of the bone had to be removed while 8 per cent remained after development. With the autogenous bone grafts only 11 per cent were removed, 89 per cent remained in place, as proven by X-ray and on rabbits four months after the insertion of the grafts and found apparently continuous with the rest of the bone.



FIG 6 —Case II Infected fracture
three weeks after injury

FIG 7 —Case II X-ray before operation show-
ing fragment of fibula to be utilized for making
grafts and pegs



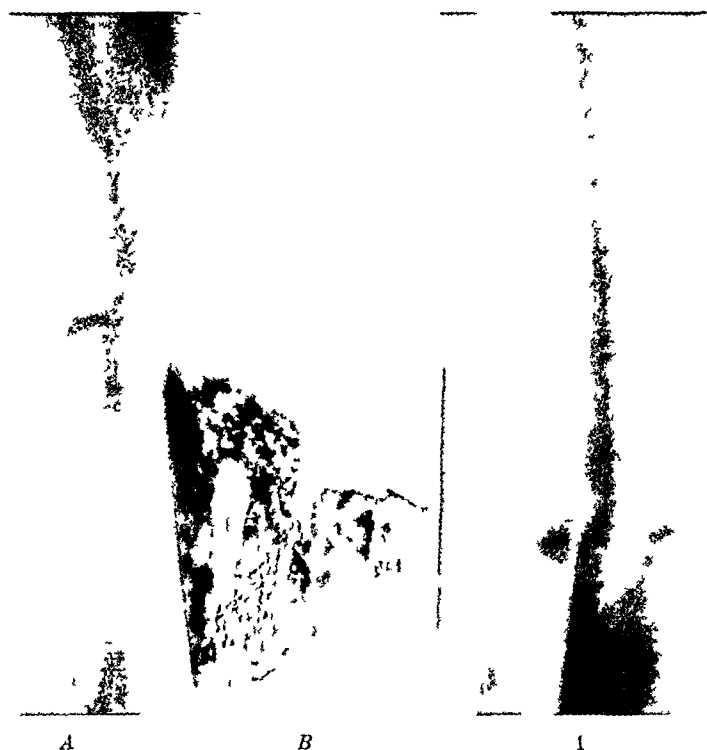


FIG 3—Case I A infected fracture of tibia and fibula before operation B after removal

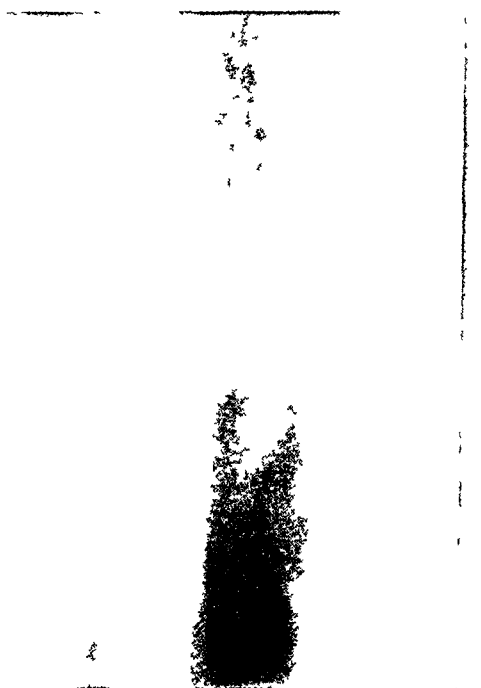


FIG 4—Case I X-ray two weeks after operation



FIG 5—Case I Ten after operation



FIG 11 —Patient twelve years old Epiphyseal separation of humerus held in place by means of an autogenous bone peg from crest of tibia X-ray one week after operation



FIG 12 —Patient ten years old Epiphyseal separation of humerus held in position by means of autogenous bone peg X-ray one week after operation on December 19 1913

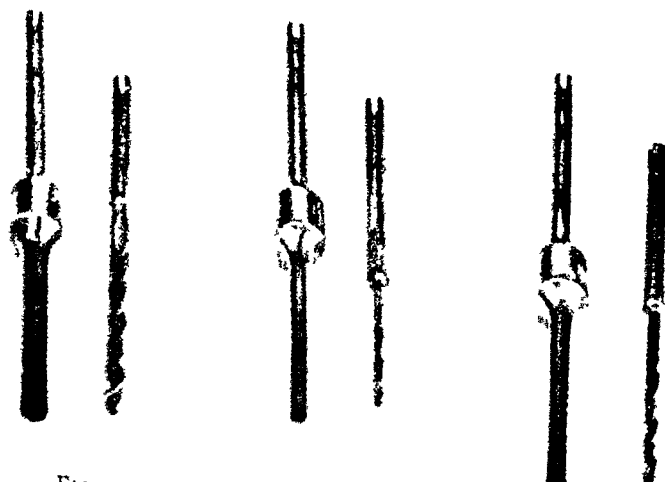


FIG 13 —Reamers or dowels with drills of same size



FIG 9 —Case III Epiphyseal separation of humerus with outward rotation of articular



FIG 10 —Case III After insertion of Lane's plate with shortening of a

AUTOGENOUS BONE GRAFTS VERSUS LANE'S PLATES

These two series demonstrated experimentally First, a foreign body is far more apt to give trouble in the presence of infection than an autogenous graft and, second, an autogenous bone graft will "take" in a proportion of cases in the presence of various types of acute and chronic infections Not for one moment, however, do we want to be understood to advocate any relaxation in aseptic technic, for absolute cleanliness is as essential in this class of work as it is in any other field of surgery

CASE I demonstrates better than any other case we have had the possibility of bone grafts taking in the presence of active infection

CASE I—Young man, twenty-two years old, compound comminuted fracture of left tibia and fibula eleven weeks before admission to the hospital X-ray (Fig. 3) showed not only the fracture but a detached piece of bone (Fig 3, B), and, on exposure of fragments, pus (smears of which showed the colon bacillus predominating) was found permeating all the tissues and about 200 c c escaped after incision of skin

It was decided to try an autogenous bone inlay graft in spite of the infection This was done on December 29, 1913, and as follows Incision was made and dead bone removed, after which two parallel circular saws were used for making a groove, the pieces removed being utilized for the manufacture of five bone pegs, one of which was inserted as an intramedullary peg in the fibula The other four were employed to hold in place a graft which had been removed from the upper part of the tibia This last graft was obtained with the two circular saws, but now being separated by a washer, the thickness of the "set" of the two saws, so as to make the graft fit tightly in the groove prepared for its reception In other words the washer allows for the "saw dust" Figs 4 and 5 show the case in two weeks, and ten months, respectively, and the patient has a perfect functional result without any of the pegs or grafts ever coming to the surface—and this in spite of the fact that there was almost constant drainage of pus for about two weeks following the operation

The oldest case in which we have employed an autogenous graft in infected fields is sixty-six years, this also being a compound fracture of tibia and fibula Fig 6 shows the leg on admission three weeks after injury, Fig 7 the X-rays before operation and Fig 8 the X-ray three weeks after operation. This old gentleman is still in the hospital (four weeks after operation) with every indication of having good union of tibia, but the intramedullary peg in the fibula has escaped from the lower fragment The graft and pegs were made from the piece of the fibula seen

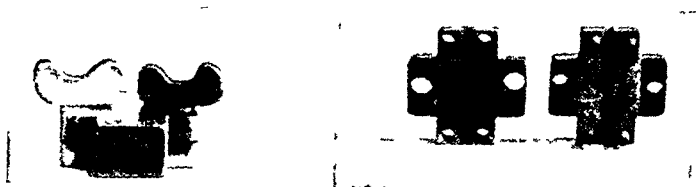


FIG 14 —Mould for making screws of autogenous bone pegs

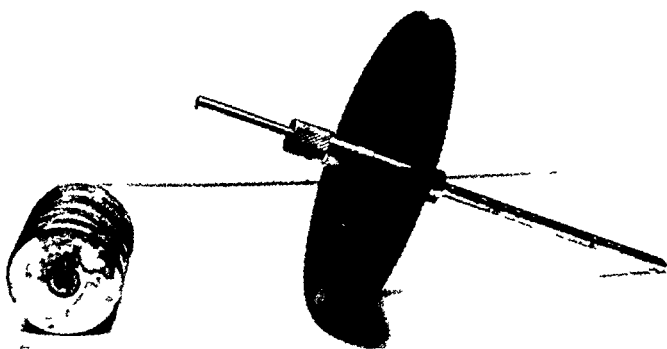


FIG 15 —Parallel saws and guide Notice different sized washers on the shank w inserted between the saws

AUTOGENOUS BONE GRAFTS VERSUS LANE'S PLATES

fect) arm With this exception the boy obtained a perfect result and it will be most interesting to watch the future development of the length of the arm without the plate

Figs 11 and 12 show two similar cases in which autogenous bone pegs were employed instead of Lane's plate and, while the time has not been as long, as yet there are no signs of shortening and both results are perfect as regards function. Both of these cases have been done over a year and the case in which Lane's plate was employed showed shortening in about six months, which at first was thought to be due to disuse of arm, but after return of full use of the arm and increased exercise it failed to develop as rapidly as the other arm

Every surgeon who expects to do any of this type of bone work should be equipped with an efficient electric motor, and we have found a friction-driven motor far more satisfactory than the heavy gear-driven motors on the market under various names

The hand gear motors are heavy and cumbersome, while with a flexible shaft the surgeon has no weight to hold—in addition to this the friction-driven motor possesses the advantage of not breaking the bone, should the saw or dowel bind—a condition of affairs not at all infrequent, no matter what type of machine is being employed When binding occurs with a gear-driven machine without a flexible shaft something is going to break and it is more apt to be the bone than the gears or saw A foot control so arranged as to regulate the speed of the motor as well as to turn on and off the current is of great comfort and safety to the surgeon Before any surgeon tries to use an electric motor he should practise on animal bones and thoroughly understand how to handle the machine in every respect All metal parts of the machine which come near the field of operation can be boiled and the flexible shaft can be covered with a sterile bag about four feet long, three inches wide, open at each end, and tied with a purse string

In the *Journal of the A. M. A.*, April 4, 1914, we published a description of our dowels or reamers which we had then been using about two years and have found satisfactory in every detail

These, as can be seen in Fig 13, are simply three cylinders of different sizes, at one end of which is a sawing edge This end is placed over the fragment of bone to be fashioned into a peg and then the motor started It only requires a few seconds to obtain a peg several inches long The size of peg required depends on the strain to which the peg is to be placed We have usually employed the smallest size, though for an intramedullary peg the largest size is most frequently used The strength of these pegs is surprising to one unaccustomed to them In making these pegs it is best to allow a few drops of normal saline solution to play in front of the cutting edge so as to prevent any possibility of heating the

between the two fractures of this bone. As this patient had ankylosed and bent knee on the other leg this shortening of a two inches makes no difference as regards the usefulness of leg.

We next determined to ascertain the results of a foreign body placed in the epiphyseal line upon the future growth of that bone of long diameter in comparison with an autogenous peg under similar conditions.

A small vanadium steel screw was placed in the epiphyseal line of a series of 10 young rabbits varying in age from 4-6 weeks. This was done through as near an aseptic field as possible to obtain and all rabbits showing signs of infection were discarded. The hair was removed with barnum and starch and the field cleaned up in the usual manner—X-rays were taken on the following day to ascertain accurately the relative position of the screw and at the end of six months all the rabbits were killed. In 4 of these there was a shortening of the tibia having the screw, varying between one and two centimetres. There was no ascertainable difference in 6. In this series there were 12 rabbits that had to be discarded because the screw was not in the epiphyseal line, and 7 on account of sinuses and infections.

An autogenous spicule of bone was placed in the epiphyseal line in a series of 12 young rabbits in a manner similar to that in which the screw had been placed, and in none of these cases was there any shortening—rabbits were killed in the same length of time. In other words, with steel screws, 4 of the cases showed shortening in the long diameter, while with the bone pegs there was no shortening in any case.

Meissenback, in 1910, injected sterile water, tincture of iodine, carbolic acid, formalin, various bacteria, etc., in the epiphyseal line of a series of hares, and found some of these, formalin especially, retarded osteogenesis, but on the other hand concluded a "retardation of growth may occur if the zone of provisional calcification is destroyed or if this zone is infiltrated by excessive blood clot or by inflammatory processes." It is this permanent destruction we feel occurs in placing a screw in the epiphyseal line, while with an autogenous bone peg such destruction is not permanent.

The importance of this part of the work is shown in the case of a small boy, aged ten years, who had an epiphyseal fracture of the femur with rotation outward of the articular head of the femur to such an extent it was impossible to reduce it without amputation (Fig 9). The fragments were returned to their normal position, as shown in Fig 10, and held in position by means of Lane's plate. This operation was done on September 1, 1914, the date on which the plate was placed. There was about three centimetres shortening of the

PAPILLOMA OF THE GALL-BLADDER

REPORT OF 85 CASES

BY HAMNER CARSON IRWIN, M D

AND

WM CARPENTER MACCARTY, M D

OF

ROCHESTER, MINN

(Mayo Clinic)

PAPILLOMATA of the gall-bladder have been seen so frequently in the experience of the writers and have received so little attention in literature that it seems advisable at this time to describe and record the condition somewhat in detail, especially since they belong to the neoplasms, a group which, as our knowledge increases, is becoming more intimately associated with chronic inflammatory reaction

In 1909 one of us (MacCarty¹) included and classified the condition, reporting one case in a series of 365 gall-bladders which had been removed at operation. It was described as a part or a stage of a reaction of the tissues of the gall-bladder to one or more irritants

In order to emphasize that pathologic conditions in the gall-bladder are actually stages of inflammatory reaction and be able more clearly to understand the possible relation of papilloma to other reactions, it seems best to re-describe the classification and terminology

In the series of 365 gall-bladders the lesions grouped themselves in the following manner

I *Cholecystitis Catarrhalis Acuta*—In this group were placed gall-bladders which retained their general normal characteristics in regard to size and color, both inside and outside, with the exception that the villi were congested, infiltrated with lymphocytes, and more prominent than normal. The lymphocytic infiltration often extended into the other layers of the wall. The condition occurred with or without stones. Attention was first drawn to this early reactive condition by the examination of excised gall-bladders which contained stones, but which grossly showed no apparent changes. Upon microscopic examination, however, the mucosa was infiltrated with lymphocytes and

¹MacCarty, W. C. The Pathology of the Gall-bladder and Some Associated Lesions. *Ann. Surg.*, 1910, 11, 651-669

bone Not infrequently one can obtain several pegs from a fractured spine. In very oblique fractures it is not necessary to use an inlay graft simply to nail the fragments together with several of these pegs.

Of course, the drills correspond in size to the pegs. If one wants to fracture an autogenous bone screw this is easily done by placing a peg in a (Fig 14) and screwing down the "lugs." This impresses us as being a refinement and not possessing sufficient advantage to justify the waste of

The grafts can be held in place by catgut, but this requires about 20 minutes to thread in place as it does to make and insert the pegs, and a graft held by catgut is not as firm as one anchored with the pegs.

We have found the parallel saws (Fig 15) easy and quick to operate and sure that having this little washer to place in between the two blades to remove the "saw dust" makes a far more satisfactory and certainly a more efficient operation and does away with the necessity of calipers or any other form of measurement.

It is occasionally necessary to remove bone from parts remote from the fracture and for this purpose we have always employed the saw of the tibia. This should never be done except when absolutely necessary, for such practically means two operations. If one is prepared to do these operations and has practised on fresh animal bone, it is not so difficult to handle the instrument, there is no reason why they should not be done quickly and accurately, but it is most certainly an operation to be undertaken "lightly and ill-advisedly."

We have made no mention of the rôle played by the pegs in the repair of fractures, nor have we advanced any theory concerning the life of the grafts or pegs as regards their absorption or their use simply as a framework for new bone deposits, for to consider these points would constitute a separate essay. To be convinced of this one has only to review the literature published on these subjects in the past two or three years and then to consider the existing controversy, some of which seems to be due to a difference of opinion of what constitutes the true periosteum, whether the outer fibrous layer or whether taken in conjunction with the underlying layer of osteoblasts.

SUMMARY—First, Lane's plate or any foreign material interferes with osteogenesis in region of fractures.

Second, In the presence of the various types of infections, metal plates have to be removed—autogenous grafts seldom do.

Third, Lane's plates placed in the region of the epiphyseal joint limit the growth of that bone in the long diameter in 50 per cent of cases, while autogenous pegs do not.

Fourth, A certain percentage of Lane plates have to be removed whether in the presence of infections or not.

V *Cholecystitis Catarrhalis Carcinomatosa*—In the first series of 365 gall-bladders there were three cases of cholecystitis catarrhalis chronica which were complicated by carcinoma. Since this report all specimens, from January 1, 1907 to January 1, 1915, have been studied. The complete series, inclusive of the 365 specimens already reported, consists of 2168 specimens, of which 25 definitely belonged to this group. There were knob-like outgrowths composed largely of epithelium which was in a stage of hyperplasia, differing apparently from simple hyperplasia in that the nuclei were large, irregular in shape and size, and had irregularly distributed chromatin.

There were areas, however, which were indistinguishable from normal or hyperplastic glands. The more extensive outgrowths arose from the mucosa and possessed a base not unlike that seen in the papilloma. The body of the growth is composed of masses of epithelial cells which, upon high-power examination, present extensive irregularities in the size, shape and distribution of the chromatin granules. Differentiation between this group and Group IV (*cholecystitis papillomatosa malignum*) must be made with reserve, because it is possible that the one is but a stage of the other. No specimens in the series presented sufficient evidence for grouping both conditions under one heading. Earlier stages of carcinoma of the gall-bladder must be found and studied before the life-history of the epithelium can be accurately pictured.

VI *Cholecystitis Chronica*—In this group was placed a condition, gradual stages of which were seen in specimens of Group II. The apparent continued desquamation of the apices of the villi is associated with proliferation of the connective tissue of the villi and submucosa. The surface, which is normally regular, contracts irregularly and leaves ridges of scar tissue. Upon microscopic examination the inner surface was seen to be void of epithelium and the mucosa was replaced by scar tissue. The process was not always complete over the whole gall-bladder, as a result of which areas of the condition described in Groups I and II were often seen. The condition occurred with or without stones. It was classified under the term *cholecystitis chronica* because the mucosa was almost completely destroyed and the process was apparently a chronic one involving the other coats of the wall.

VII. *Cholecystitis Chronica Cystica*—A stone was frequently found lodged in the cystic duct or in the valves of the neck of the gall-bladder, thereby causing obstruction and distention of the organ. This resulted in thinning of the wall and destruction of the mucosa or flattening of the scar tissue ridges in the chronic cases.

leucocytes The diagnosis was sometimes made during cholecystectomy by the presence of thick viscid bile, which seems to indicate activity of the glands of the mucosa and perhaps partial obstruction of the natural drainage Other specimens in which no stones were presented this same condition, and clinically gave a picture of cystitis The stones which occurred in these cases were usually small, and it is quite possible that in some cases similar stones may have passed through the ducts in the cases in which none were found The condition may have been simply the forerunner of stones An early reaction of the mucosa was seen again in association with changes, which constitute the second group

II *Cholecystitis Catarrhalis Chronica*—These specimens from Group I only in degree, one portion of the gall-bladder belonged to the first group and another portion to this group The principal change grossly consisted of an "erosion" of the apical villi They presented themselves as yellow specks scattered over the mucosa Otherwise the mucosa appeared to be normal or only slightly inflamed This condition was described as a "strawberry" gall-bladder because of the resemblance of the yellow specks to strawberry seeds Microscopically, one easily recognized that the epithelium of the villi was lost and replaced by scar tissue Clinically, there was nothing to distinguish this group from Group I It was found without stones

III *Cholecystitis Catarrhalis Papillomatosa*—In this group there was only one specimen One of the villi was enlarged and had a papilloma The condition was associated with stones and catarrhal reaction in the mucosa The papilloma was 2 mm long and about 1 mm in diameter The cells of the epithelium covering the papilloma were regular in size and shape and possessed no irregularities

It is this group which forms the basis of this report because it has been so frequently found, since the original report

IV *Cholecystitis Papillomatosa Majusculum*—Like papillomas in other portions of the body, those in the gall-bladder undergo a similar or perverted epithelial hyperplasia, which manifests itself in the reduplication of the rows of epithelial cells Upon high-magnification the cells present the cytological changes which are characteristic of secondary epithelial hyperplasia Such cases have been found at laparotomy, at which time portions of the gall-bladder were removed for examination This type does not occur in this series because all the cases were studied at exploration of inoperable cases

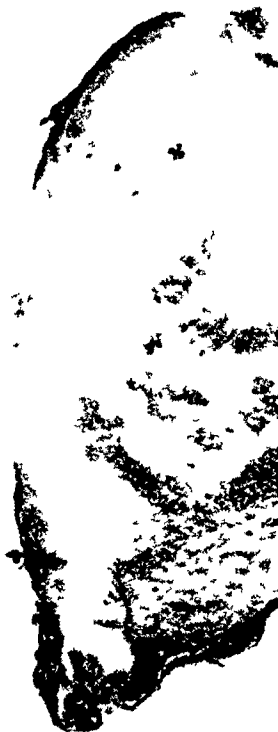
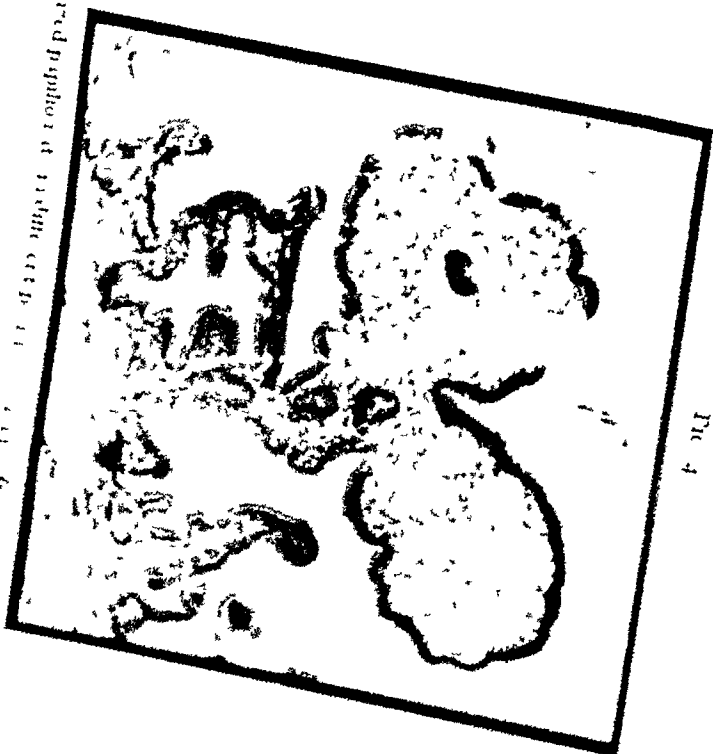


Fig 3



Fig 4



Figs 1, 2, 3 and 4—197358 165030 178951 and A 99409

Gall bladder which contains brown seed particles in the contents

The stone was usually firmly embedded between the val could not be moved in either direction. Microscopically the thin layer of connective tissue in which traces of the nuclei muscle-cells were sometimes found. Such a gall-bladder attain size, and was usually the type which presents itself as a large tumor.

VIII *Cholecystitis Purulenta Necrotica* —During any stage of inflammation, which has been described, obstruction to the cyst plus a pyogenetic infection, disturbance of the circulation and abscesses in the wall of the gall-bladder may occur. Such were usually distended, dark blue or black, the contents pus and usually not bile-stained.

Pericholecystitis acuta and chronica were considered as any of the above-mentioned degrees of inflammation. Even the earliest degree of cholecystitis catarrhalis acuta the process tended to the serosa through the lymphatics, and it was not to see adhesions, usually to the omentum, duodenum, stomach, and transverse colon in this stage.

Since the original report was made more gall-bladders were removed in earlier stages of inflammatory reaction and this was probably responsible for the frequency of the papillomatous which has been recently found.

Out of 2168 gall-bladders which have been examined since January 1, 1907 and January 1, 1915, 85 specimens have been examined of which one or more papillomata have been seen (Figs 1-7).

In all cases the mucosa was intact. The papillomata were twice to 5 or 6 times the length of normal villi. They were pedunculated, frequently racemose, and usually white or yellow. They appear in any portion of the organ, being confined neither to the neck nor the fundus.

Upon microscopic section they appear to be hyperplastic. The connective tissue elements of which present an hyperplastic condition. The connective tissue and glandular tissues are greatly increased, being so distorted that sections cut the glands in many different directions. The epithelium of the glands is hypertrophic and occasionally hyperplastic, and practically always completely covers the growth.

In the stroma one often finds large round or oval cells filled with fat (Figs 8 and 10) or some fatty substance, this condition being responsible for the yellowish gross appearance of the organ.

In no case were there any signs of early carcinoma, a



Fig 9



Fig 8

Fig 10

FIG 5

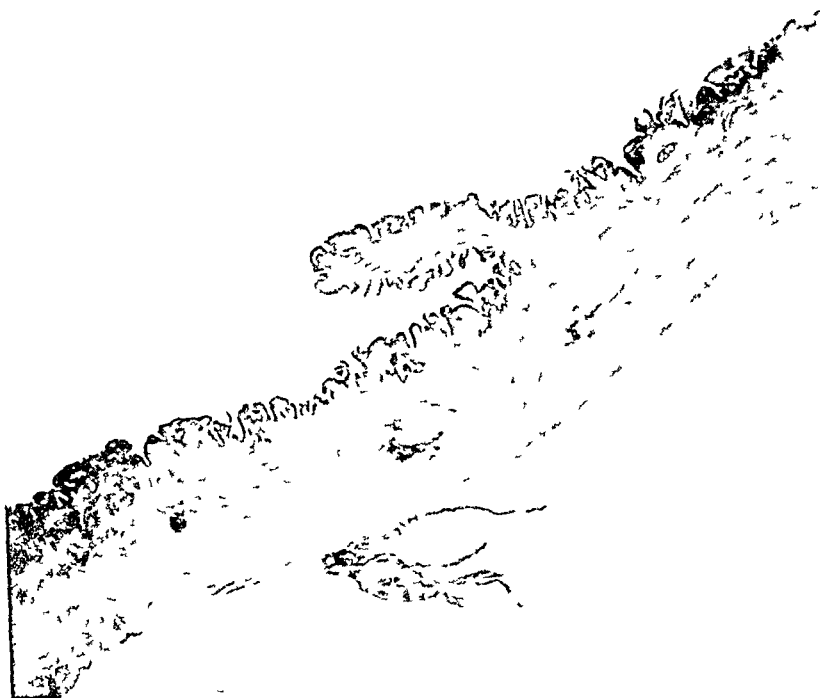


FIG 6



FIGS 5 and 6 — A 96563 and A 98808 Low-power sections showing the papilla from the mucosa

lar hypertrophic conditions of the villi have been seen in association with carcinomatous outgrowths of the gall-bladder

The condition occurred in cholecystitis catarrhalis acuta, cholecystitis catarrhalis chronica, cholecystitis catarrhalis cystica, cholecystitis catarrhalis carcinomatosa, and cholecystitis catarrhalis purulenta necrotica

It occurred with and without the association of stones and was more frequent in females than males, probably due to the fact that more gall-bladders were removed in females

The writers take the liberty of reporting these cases in order to stimulate observers to watch for the association of the condition with malignant changes in the mucosa, since it is associated with chronic inflammation and has been associated with late carcinoma

It is quite possible, in the light of recently discovered facts relative to the stages of epithelial hyperplasia from chronic irritation, that these fibro-epithelial proliferations might also present the stages which are apparently a part of a cytological reaction, which ends in a malignant condition

OCCULT STRANGULATED INGUINAL HERNIA

Rokitansky a good many years ago described a number of pouches in the peritoneum of the inguinal region, and herniæ into these have been described by Brunner, Havage, Englesch, Wagner and others. The question as to whether or not these pouches have any etiological bearing on this type of case is at present merely problematical. These fossæ may be demonstrated easily by placing the subject face downward on the dissecting table and working from before backward.

Eppinger has shown that the inguinal canal may be arbitrarily divided into three portions:

- 1 Extending from the anatomical internal ring to the point where the infundibuliform fascia enters the transversus abdominis. In this portion the interspace between the peritoneum and the fascia transversalis is filled with very loose and lax areolar tissue containing fat. The fascia transversalis is much more firmly attached to the transversus than to the peritoneum.

- 2 This portion is surrounded by the transversus and the internal oblique muscles, closely embraced by them and approximately 10-12 mm in length.

- 3 Extending from the internal oblique to the opening in the external oblique. In this portion the surroundings are again lax and soft, yielding and distensible. In the first and third portions the adventitious sacs are most commonly found, the second portion is more rarely the site of a diverticulum from the sac.

While the reduction of a hernia in the inguinal canal *en masse* naturally presupposes the application of taxis, still the foregoing may in a measure explain the spontaneous reduction of the sac and its contents in the following cases. With a sac with a narrow neck and placed in a canal that in the first and third portions is naturally lax and yielding and the association with a deficient second portion, one can readily see that a reduction *en masse* can take place spontaneously, all the more so if the sac is short and some of the peritoneum of the parietes is drawn into the canal where by its own elasticity it acts as a natural tractor and exerts a pull from within. As the sac at operation lay between the peritoneum and the transversalis fascia, the only evidence we have that the sac was ever in the canal is the patient's history, the first patient having actually worn a truss and the second giving a distinct story of a lump in the groin for two weeks, and in both cases the sac was large enough to have a portion of small bowel caught in the constricted neck.

OCCULT STRANGULATED INGUINAL HERNIA, SPONTANEOUS REDUCTION "EN MASSE"

BY MILTON R. BOOKMAN, M.D.

OF NEW YORK

ADJUNCT ATTENDING SURGEON, LEBANON HOSPITAL

THE strangulation of an inguinal hernia offers, as a rule, no opportunity for niceties of diagnosis and treatment, but in the two cited herein all the symptoms and signs of this condition were present with the exception of a palpable tumor, either in the canal or scrotum.

In one of the Arris and Gale lectures for 1900, Moynihan described a number of unusual herniæ occurring in the inguinal region and among which is noted a type that he calls "reduction *en masse*," to differentiate it from the group of properitoneal herniæ. The true inguino-peritoneal hernia must have (a) a hernial sac having two loculi, (b) the inner loculus lying between the peritoneum and the transversalis, (c) the outer loculus lying in the inguinal canal. In rarer instances, between the layers of the abdominal wall, (d) the loculi opening into the abdomen by a single orifice, the abdominale.

Another important feature of this type of case is the association with a maldescended testis, 23 in a series of 59 recorded showing the defect, the coincidence being attributed to the fact that the hernia interfered with the usual descent of the accompanying sac.

Moynihan insists that the term "reduction *en masse*" be reserved for those cases that have *the mutual relation of the contents undisturbed*, where the entire mass is found behind the inguinal and fascia, that is to say, not in the canal.

In searching the museums of London for specimens of inguinal and properitoneal herniæ, he found that most of the specimens of this class, *i. e.*, properitoneal hernia, were labelled as having been reduced *en masse*, which he regards as an error, and he goes on to say that true cases of complete reduction are rare indeed, and that he observed the hernia is of long duration with loosening of the surrounding structures and usually the result of long and ill-advised taxis. Herniæ of this variety were first described by Saviard and later by Le Dran, Lafaye and Richter.

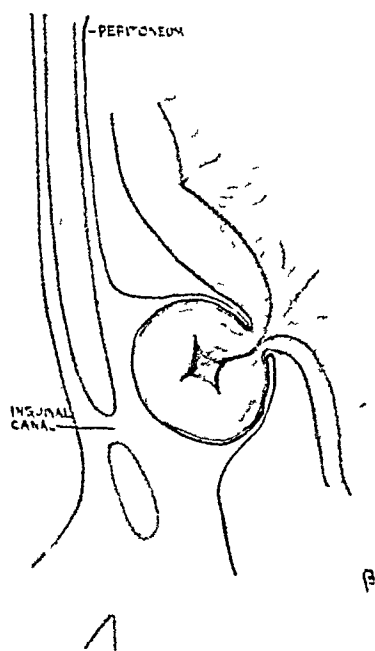


FIG 1 —Cross section at site of internal ring (semidiagrammatic)

CASE I—A. B., No 42,982, aged sixty-three, was admitted to Lebanon Hospital in the service of Dr Parker Syms, on November 7, 1913, with the following history Has had a bulge in right groin for the last four years and for which he wore a . . . Three days ago he was seized with pain in this region which localized at first, but later spread over the entire abdomen . . . to vomit with the onset of this pain and continued to do so . . . the time of admission Bowels were constipated Never . . . similar attack His physician made a diagnosis of intestinal obstruction and advised his removal to the hospital for operation

Physical Examination—The patient looks acutely ill . . . features are drawn, his whole appearance denoting the fact that he has recently lost a large amount of fluid Chest shows signs of an old emphysema Abdomen is much distended and very tender to the touch, especially over the right Poupart's ligament, there is distinct rigidity His scrotum is devoid of a sac . . . finger in the canal elicits nothing abnormal in the way of tenderness or impulse on coughing Pulse 100, respiration 30, temperature 98°

Operation (November 7) —Taken to the operating room as soon as preparations were complete Low right rectus incision above Poupart's ligament under novocaine 1-200 On . . . the peritoneum a quantity of serosanguineous fluid escaped . . . a mass was found at the site of the internal ring, further . . . operations were precluded by the patient straining so the local anesthesia was supplemented by ether by the drop method A . . . distended bowel led into this mass and a loop of collapsed . . . emanated from it The ring of peritoneum that caused the . . . constriction was incised, liberating from the sac about ten . . . of very doubtful looking gut, the peritoneum covering tion of bowel was granular and very dusky, but after some . . . "ing" with hot towels the color returned somewhat to normal . . . not sufficiently to permit it to be returned permanently to the . . . men A suture was passed through the mesentery and the . . . replaced temporarily within the abdomen subject to . . . inspection The sac was explored and was found to be . . . and gangrenous, and was removed by transfixing the base . . . sac within the abdomen, ligating the neck and ablation

The questionable bowel was now withdrawn from the . . . men by means of the suture through the mesentery and . . . found to be granular in appearance in certain small areas . . . condition of the patient precluded any radical procedure . . . segment of bowel was carefully surrounded by several . . . drains and some loose gauze and replaced just below the

OCCULT STRANGULATED INGUINAL HERNIA

which was partly closed with several sutures of silkworm gut. On the fourth day there was some discharge of intestinal contents through the wound, but this ceased spontaneously in about a week. Patient discharged with a small granulating wound on November 26, future dressings being done by his own physician. Subsequent report a few weeks later showed the wound healed and the patient back at work.

CASE II—J. R., No. 39,863, aged thirty-three, was admitted to Lebanon Hospital in the service of Dr. Parker Symms, on January 22, 1913, with the following history. Two weeks before admission while at work he lifted a heavy weight and had a sudden attack of pain in his right groin. This pain, he avers, was coincident with the appearance of a "swelling" in the location of the external ring. When he first noticed this it was about the size of a cherry but gradually became larger and more painful, less so at night. He says that he was always able to reduce it but with some discomfort, with the exception of one occasion two days before admission, when he had his physician do this for him. Was extremely perturbed over this and had very little appetite. Bowels constipated. His chief complaint on admission to the hospital was pain in the abdomen, chiefly in the region above the right Poupart's ligament. Pulse 80, temperature 99°, respiration 20.

Examination on Admission—Showed nothing abnormal except some tenderness at the site mentioned above. In view of the fact, however, that he had had a mass reduced by his physician two days previously, he was kept in the ward, up and about, with the idea of demonstrating a hernia.

Two days later his pain returned with increased intensity and he vomited several times. Examination at this time revealed nothing except the fact that he had more marked tenderness in the lower part of the right side of his abdomen. The external ring was not excessively patulous nor was there any suggestion of any sac and its contents in the canal, no impulse on coughing.

Operation (January 24, 1913)—Low right rectus incision, with the opening of the peritoneum there was an escape of sero-sanguineous fluid. A distended loop of bowel led into a small opening at about the site of the internal ring, from which was gently removed a loop of bowel about three inches long. This was slightly dusky in color, but soon returned to normal. The small opening led into a small pouch which was obliterated from within by a few sutures of Pagenstecher. Abdomen closed in layers without drainage. Discharged cured on February 22.

Both of the cases reported above had symptoms of an intestinal obstruction, both gave a history of having had a hernial protrusion, one

THE TREATMENT OF BENIGN PAPILLOMATA OF THE URINARY BLADDER WITH HIGH FREQUENCY CURRENTS*

BY EDWIN BEER, M D

OF NEW YORK

ALTHOUGH this new method of destroying vesical tumors is in use only a short time (1910), we have had sufficient experience with it to enable us to decide when and how it should be employed. Papers have been published bearing on this subject in America, Germany, France, Italy, Austria, Belgium, Holland, England and other countries. Almost all surgeons report their experiences in a small series of cases. In America a large number of papers have appeared, covering a goodly number of cases. Practically every surgeon has reported favorably, bearing out the experience that I have had in my own cases.

It is no longer necessary to work with the more complicated operating cystoscope to destroy these papillomata, though it is necessary to use such instruments as Buerger's forceps or Young's rongeur to obtain specimens from the growths for microscopic study. The importance of this procedure I have repeatedly emphasized, as malignant growths do not respond to the treatment.¹ In the 84 cases of neoplasm of the bladder, on which I have notes, 51 were examined microscopically, and in many of these the microscope verified my suspicion of malignancy, while in a smaller series it upset the clinical impression obtained by means of cystoscopic examination. Occasionally the microscope may be misleading, as specimens taken from the surface may be benign papilloma while deeper parts may be malignant. After burning off such surface growth, specimens from the deeper growth can readily be obtained, and, if the operator is still suspicious of the malignancy of the growth, further specimens must be obtained and studied. All this entails but slight delay as specimens are readily obtained at the first or second cystoscopy. It cannot be denied that despite all this care mistakes in diagnosis will occur, though I feel confident that such mistakes will be rare, if one carefully weighs the evidence obtained by palpation, cystoscopy (including the response to the high frequency cauterization), and the microscopic study.

* Read before the New York Surgical Society, February 10, 1915

¹ *The Edwin Journal of the American Medical Association*, May 28, 1910; *Annals of Surgery*, August, 1911, *Zeitschrift f. Urologie*, 1912

only a few weeks, while the other had it four years and wore a neither of these cases was any attempts at forcible reduction and yet at operation the sac and its contents was found behind the muscles of the abdominal wall and in front of the peritoneum, an impression that both of these cases gave one was that of a strangulated hernia, but lacking the all-important presence of the sac in the scrotum, but the fact that they both gave evidences of having had a hernia at some previous time, coupled with the fact that the point pointed to the corresponding Poupart's ligament, was enough to lead one to believe, or at least suspect, that the condition was a strangulated hernia of unusual type.

The incisions through the lower right rectus were performed with the object in view of coming down on the seat of trouble to ascertain the true state of affairs, rather than working in a somewhat restricted field of a herniotomy incision with the object of having to make another opening above as would have been the case in the first case. The idea of repairing hernial protrusions on the peritoneal side of the abdominal wall is nothing new, Beck and Mayo clinic having called attention to this fact a few years ago. Naturally the method here employed was not the method of repair in the presence of an unusual condition was therefore adopted.

According to the classification adopted by Moynihan these cases, despite the fact that the sac was found in the properitoneal space, cannot be listed as properitoneal herniæ because of the absence of the sacs, but the presence of the sac and its contents undisturbed, standing the absence of forcible taxis, these cases must then be placed under the heading of "reduction *en masse*," spontaneous and occult in nature.

HIGH FREQUENCY CURRENT FOR BLADDER PAPILLOMATA

the bladder wall at only one place, the pedicle, theoretically the bipolar current would seem to have a distinct advantage. But as the growths are usually in contact at numerous points, this theoretical advantage, based on the concentration of the waves of current at the narrowest point, cannot regularly obtain. Moreover, those who make use of only the bipolar current are frequently annoyed by the fact that the dead tumor remains attached by its more or less dead pedicle for a very long time. The Oudin current, by virtue of its explosive action, in a great measure prevents this. Because of these considerations, because of its less marked distant action, and its more perfect control, I use the Oudin current² much more frequently than the d'Arsonval.

Further experience may demonstrate that a combination of both currents—first, a brief bipolar treatment and subsequently the use of the unipolar current—may give more rapid results, such a preliminary d'Arsonvalization followed by an Oudinization would combine the virtues of both.

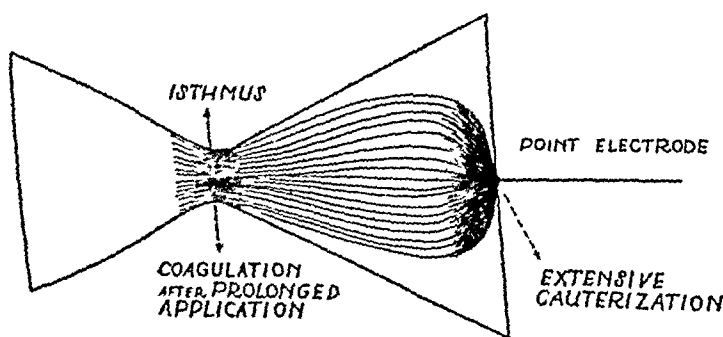


FIG 2 —Oudin or unipolar current

In the literature, one reads occasionally that this method of treatment should not be used in large papillomata. I believe this is a mistake and that size presents no limitations to this method, as I find that I can employ it satisfactorily in even the largest growths. The largest growth that I have seen, surely as large as a good-sized orange, I was able to destroy in six sittings. At the second sitting I was able to obtain, through the sheath of the cystoscope, enough tumor tissue to fill a 60 c.c. bottle. Consequently, from my personal experience, I would emphasize the point that size is no contra-indication to the use of the therapy under discussion. On the other hand, tumors situated at the neck of the bladder, especially those that bleed profusely when injured by the introduction of the cystoscope, will usually have to be operated

² As seen in the specimens it can produce a very similar distant action, to that of the bipolar current, provided the applications are very prolonged.

In America the therapy is called by various names. I call it high frequency cauterization, till we find out exactly what effects are produced. Some call it "sparking," translated French by Heitz-Boyer as "*étincilage*," and others incoagulation. In Germany, where the bipolar, d'Arsonval current is generally used, owing to the fact that they have neither the electrodes to carry the Oudin current nor (apparently) the apparatus for producing it, the method has been termed "coagulation." In France both electro-coagulation and *étincilage* are applied to the method under discussion.

There appears to be a slight difference in the way the Oudin or the d'Arsonval currents act, when tested on raw beef outside the body. The Oudin or unipolar current produces a more violent action at the point of application of the electrode, and a less though distinct distant action, apparently a cauterization and

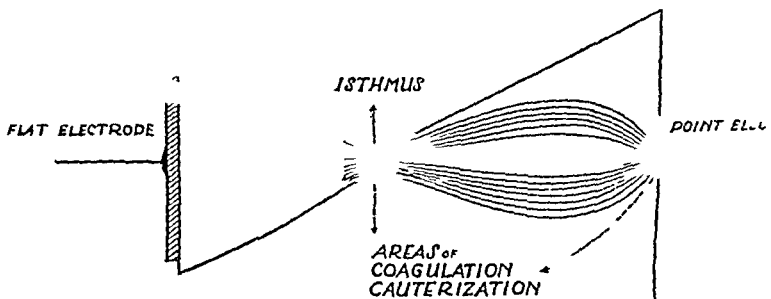


FIG. 1.—D'Arsonval or bipolar current

tion. There is also what looks like an explosive action, as part is broken off from the growth. On the other hand, the bipolar has none or very slight explosive or disruptive action. Its action is less and its distant action, coagulation by heat, is more in virtue of this, which makes its action less controllable, inferior to the unipolar or Oudin current for the purpose of destroying papillomata. In view of this distant coagulation and the mummification induced, the occasional hemorrhages following the bipolar current seem to be readily explained. These differences of actions of the two types of high frequency currents are demonstrated on a raw piece of beef which has been cut, as indicated by the accompanying illustrations (Figs. 1 and 2).

The more active concentration of the bipolar current at its narrowest point, would appear *a priori* to be a distinct advantage in destroying the tumor's pedicle at the very first sitting. If the tumor were pedunculated and floating freely in the lumen and in

HIGH FREQUENCY CURRENT FOR BLADDER PAPILLOMATA

(3) All malignant cases should be excluded from this therapy.

(4) The Oudin current is to be preferred, at the present time, as its effects are more readily controlled, and it has certain other definite advantages over the d'Arsonval current

(5) The large size of a papilloma is no contra-indication to the use of this therapy.

(6) Inaccessibility, traumatic severe hemorrhage due to the introduction of the cystoscope, intolerance of the patient, and malignancy are the important contra-indications

(7) The end results are highly satisfactory My original cases are well over 4 years

upon, preferably suprapubic cystotomy and Paquelinization give relief in apparently hopeless cases. Patients that are int cystoscopy and growths that are inaccessible, hidden in dive pouches, will also require operative interference. Whether instrument of Lohnstein, for retrograde applications, will help first group of cases, the future will demonstrate.

Another point frequently encountered in the literature of ject is a certain scepticism as to the end results. It may be to speak of these, but from my own experience I feel certain cases can be definitely cured by this method. Only re-examined my earliest cases, 4 years after destruction of and there was no sign of recurrence. Another case $3\frac{1}{2}$ y completion of the treatment is also absolutely well. By re every 3-4 months one can control these cases most satisfactorily. I believe that if there is no sign of recurrence *in loco* at the re-examination, there is very little reason to apprehend a relapse or a recrudescence of the original tumor. In some same cause that led to the original tumors or tumor may produce growth in some other part of the bladder. This I have seen times.

The peculiar reaction in the bladder wall, following the high frequency cauterization, has misled a number of observers. The fact that I called attention to it, in word and picture, years ago in the ANNALS OF SURGERY, August, 1911. The thickening of the adjacent bladder, following vigorous suggests an infiltration of a malignant neoplasm. Barney such an area, thinking it was carcinoma, and histological of neoplasm was visible.

In closing, I must again emphasize the importance of specimens for microscopic study, as all tumors that are malignant must be excluded from this method of treatment. I usually at the first cystoscopy, unless they are frankly carcinoma, I do not see extensive destruction, *i.e.*, good response to treatment, I excise several pieces of the growth, at the second. Cases that are not definitely benign and all malignant cases by wide excision.

Conclusions — (1) Results with high frequency cauterization have been satisfactory.

(2) By careful weighing of the evidence obtained by response to cauterization, palpation and microscopic study of voided specimens, malignant papillomata can usually be



Fig. 1—Fracture of the lower end of the radius and ulna with anterior displacement of the radius. a, lower fragment of the radius, a', fracture surface of lower end of shaft of radius, b, fracture surface of ulna.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY

Stated Meeting, Held February 10, 1915

The President, DR FREDERIC KAMMERER, in the C.

OSTEOPLASTIC REPAIR OF SKULL DEFECT

DR ROBERT T MORRIS presented a man, twenty-five y who had received a compound fracture of the skull in the temporal region seventeen years previously There resulted about the size of a silver half dollar which was covered over and fibrous tissue only, and pulsations of the brain could be felt beneath There was some loss of power of the left hand and it began from the left hand fourteen years ago, followed by seizures These had continued for fourteen years, the patient having as many as five attacks in the course of a week, two in a single night

The tissues in the area of defect were dissected free, dural tissue separated and the scar tissue excised from the cortical bone. A Cargile membrane was introduced for the purpose of prevention of adhesions and an osteoplastic graft from the tibia was placed in the cranial opening

The patient has had no epileptic attacks since the operation nine months having elapsed

The point of special interest was the firmness of the graft It seemed almost as though the patient had bony union though osteoblasts may not construct new bone from the pericranium, it is possible that new bone cells from the graft formed a firm union with cranial bone

FRACTURE OF THE LOWER END OF THE RADIUS AND THE ULNA WITH ANTERIOR DISPLACEMENT OF THE CARPAL FRAGMENTS

DR J M HITZROT presented a patient brought to the Hospital by Dr J H P Hodgson, August 1, 1914, with a fracture having been thrown from a horse about ten hours before The patient fell with the left hand flexed under her and was

FRACTURE OF RADIUS AND ULNA

complained of severe pain at the left wrist and elbow at which joints motion was impossible. The wrist fracture was "reduced" (?) by a doctor who saw her, the arm put in splints, and she was sent to the city for the elbow lesion. Dr Hodgson brought her to the hospital at once upon seeing her.

The patient was anæsthetized, the arm examined and an anterior displacement of the head of the radius found. There was also a fracture of the lower end of the radius and of the styloid and head of the ulna with displacement of the lower fragments forward and toward the radial side. The lower end of the upper radial fragment could be readily felt on the posterior surface of the wrist-joint, while the lower end of the upper ulnar fragment was readily seen and palpable on the posterior aspect of the wrist. The deformity was unlike the so-called silver fork deformity in that the curve between the handle and the prongs of the fork was just the reverse of that seen in the typical deformity of Colles' fracture. Roberts has described this as the gardener's spade deformity.

It was found impossible to correct the fracture at the lower end of the bone by manipulation. An X-ray (Fig 1) was taken which showed a fracture of the lower end of the radius and the head of the ulna with anterior displacement of the lower fragments and posterior displacement of the upper fragments.

In the extended position traction downward upon the arm with pressure over the radial head brought about the reduction of the head of the radius without any difficulty, and no further injury at or near the elbow was discoverable. This was subsequently proven by the X-ray, which showed complete reduction of the radius.

On August 4 a three-inch incision was made over the dorsum of the wrist. The lower end of the upper radial fragment had perforated the annular ligament and its jagged end was caught in the subcutaneous fat. The whole of the extensor group of tendons was found to have dropped between the two radial fragments. The tendons were freed and retracted and the two radial and ulnar ends brought into perfect apposition. The tendons were replaced, and their sheaths and the annular ligament closed loosely with plain catgut, the skin with horse hair, and moulded anterior and posterior plaster splints applied. The patient's convalescence was uninterrupted. An X-ray picture after the reduction showed reposition almost perfect. Baking and massage were begun on the twelfth day after operation, and movements of the fingers encouraged from the start. The splints were removed on the thirty-first day and the patient regained complete use of the arm at the end of twelve weeks.

middle of the shaft with crepitus, etc. There was very little swelling of the arm and no ecchymosis. X-ray pictures taken May 20, 1914, showed a bone cyst of the humerus with a pathological fracture through the thinned-out cortical bone and with little displacement, except that due to angulation anteroposteriorly.

On May 23 a long incision was made over the outer lateral aspect of the arm down to the line of fracture, which was found to be a fracture through a bone cyst with extensive fragmentation of the walls of the cyst. About the site of the fracture and among the bone fragments there was a mass of viscid gummy material which extended from the medullary cavity into the surrounding musculature. The adjacent muscle tissue seemed to be infiltrated by a mass of more or less homogeneous cartilage-like material. Frozen sections made at the time from the viscid material obtained from the medulla were reported as a myxochondrosarcoma. The infiltrated muscle tissue and the adjacent bone were widely removed, leaving a defect of about three inches between the two bone ends.

In view of the doubtful pathology of these lesions in general and in spite of the pathological report, it seemed wisest to first try conservative measures before resorting to an amputation. With the Kenyon saw two slots were then cut in the upper and lower ends of the bone along the same longitudinal axis. A bone graft similar to the above described slots and long enough (eight inches) to maintain the length of the bone was then cut from the left tibia and with its periosteum attached was transplanted into these slots and fastened there by pressing it firmly home and by two stout kangaroo sutures wrapped about the bone at each end. The periosteum was then stitched to the periosteum of the shaft and the wound closed loosely with plain catgut and silkworm-gut in the skin without drainage, with an alcohol thymol dressing, and the arm put up in Hitzrot's modification of the moulded splints described by Stimson for fractures of the shaft of the humerus. Eight weeks after the operation the union was solid and the splints were removed, and at the end of twelve weeks complete use of the arm was permitted.

The X-ray plates taken at frequent intervals show a gradual consolidation of the callus which as is usual, is most marked on the concave side, and the bone graft is still present in the last picture taken eight months after the operation. There is as yet no indication of tumor growth.

Elmslie of London (*Brit Jour. Surg.*, 1914, vol. ii, p. 17) reviews the subject of bone cysts and gives all the various explanations of their